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Trade Commissioners and a New B.I.F. Committee.

LAST Friday week the chairman and directors of Olympia, where the British Industries Fair is to be held in future, gave a luncheon at which Mr. J. H. Thomas, Lord Privy Seal, and Mr. G. M. Gillett, Parliamentary Secretary to the Department of Overseas Trade, were the principal guests. It was stated that about £400,000 was being spent upon extensions and increased facilities in connection with the Fair. Mr. Thomas referred to the buildings as the new permanent home which he believed in days to come would become known all over the world. Later he dealt briefly with the question of unemployment and the clouds on the horizon. He desired a spirit of independence to return to industry. He had many advisers, but he had come to the conclusion that the only one solution was to use the best brains and skill in the world to place the goods at the disposal of the world. The importance of getting customers led Mr. Thomas to state that they could not sell goods without showing customers that they had the goods to sell. It seems from the speech, as reported, that the Lord Privy Seal puts down our want of success in this direction to the miserable inadequacy of our Trade Commissioner Service abroad. This may be so, but it used to be the Commissioners' complaint to us, personally, that the British foreign travellers would not make full use of them and their information facilities. From some reports we gather it to be numerically, rather than in point of efficiency, that he spoke of the miserable inadequacy of Trade Commissioners. Mr. Thomas found that we were handicapped in not having enough British representation abroad, and there cannot be the least doubt that whether we appoint more Trade Commissioners, or send Commissions to special markets,

or send representatives to survey the electrical and allied needs alone, or privately dispatch many more British salesmen expressly appointed by separate or grouped manufacturers, the effect must be all to the good for our own and other industries. There was a happy suggestion of closer co-operation between business men and the Government in removing the handicap under which we suffer through there being so many American and other commissioners in all parts of the world who could talk, give advice, and negotiate. If Mr. Thomas is out for something really big why not appoint a powerful mission to prepare a survey of the coming immense electrical trade possibilities throughout the world?

But Mr. Gillett, Parliamentary Secretary of the Department of Overseas Trade, also had something interesting to say about the British Industries Fair. While he was dealing in particular with the London end, his sentiments doubtless also apply in some measure to the Birmingham section. We quote his words as published in *The Times*:—

"He hoped that no one imagined the present Government was in any way indifferent to the importance of our export trade. They desired to help those of them who were interested in that trade, by methods of advertisement, and to acquaint them with the customers who were desirous to buy their goods. Referring to the work of the British Industries Fair, they thought that some investigation to increase the scope and value of the Fair might be helpful, and they proposed to appoint a committee which would command the confidence of all business men to advise as to the best methods to that end. He hoped the committee would take evidence from all who were anxious to help to develop the Fair. The fine buildings in which that luncheon was taking place, which were occupied practically throughout the year, provided a standard of service and comfort sufficient to satisfy the most exacting tastes whether in midsummer or midwinter. When that fact had been realised and tested by personal experience, any reluctance on the part of visitors from foreign countries, especially those in warmer climes, to visit their great Fair would immediately disappear."

Mr. Gillett expressed the hope that the proposed committee would take evidence from all who are anxious to help to develop the Fair. Seeing that the object is to stabilise arrangements for many years, the importance of this is easily recognised.

The Industrial Situation.

Everybody must have noticed the recent renewal of industrial unrest in some direction or other. Surely it is not indicative of party bias to note that since the beginning or middle of June there has been a changed atmosphere affecting industrial affairs.

Perhaps after four years of steady-going Government and the setting-up of another of very different complexion, it is but natural that the oft-stated intentions of some of the members of that new Government should encourage feelings which had lain dormant because of what were frequently referred to as improved industrial relations.

It has to be recognised that the 1929 Labour Government, without a majority over the other parties, cannot do all that it likes. If it ventures too much it is likely to be ruined by those who, while prepared to give it a fair trial, are ready to rock the boat dangerously if the national interests are seriously threatened. On the other hand, if it attempts too little, so that it fails to satisfy its electoral supporters, it may run the risk of downfall on that account. Indeed, it has been said that its danger comes more from behind rather than in front. One cannot reasonably leave such signs out of consideration when one endeavours to understand the prevalent industrial situation.

Quite recently we have noticed how our unemployment problem seems to be shrinking, and that it is not so serious as it has appeared to be from the official figures. These figures are now to be supplemented by a monthly statement in a new and altered form, as stated in our "Business Notices" to-day. It will matter little who claims at a later date to have discovered this interesting fact, but it will come as strange news to the world that we have made a habit of publishing exaggerated figures of those for whom we are unable to find work.

We are faced with simultaneous trouble in at least four great industries, *viz.*, mining, textiles, railway and engineering. All of these disagreements will fill the Government with difficulty during the recess, whether they are or are not largely due to the new Parliamentary position, and they will require close attention by industrial men, because of their effect upon the electrical and allied industries as well as upon the general consumer. In the case of the engineering trades the position is somewhat obscure. Recently the employers, while agreeing that the men should have higher wages, again expressed their inability to pay them. But a fortnight ago the Unions decided to ask for another meeting to hear the employers' "considered reply" to their application. They also urged upon the Foreign Secretary the necessity of trade with Russia. We trust that a way out will be found in all these troubles; the solution depends a great deal upon commonsense and level-headedness on all sides and a desire for the national good.

Supply Development in Scattered Areas.

In these days of great things—large consumers, heavy loads, high voltages, and so on—it is as well to take stock occasionally and remind ourselves that the big things are developments from the small. Remembering that the "grid" is necessarily the sequence of such development of electricity supply, we shall be satisfied as to the desirability of establishing nuclei of consumers, load, and mains in the outlying districts before the tentacles of the "grid" are thrown out.

To bring about such nuclei necessitates the establishment of generating centres in much the same way as the present larger generating systems were started 30 or 40 years ago. The problem, of course, bristles with difficulties—not insurmountable we suggest—of which the chief is capital cost relative to the short life required of the generating plant. A useful suggestion, which we commend to the serious consideration of supply engineers, was made by Mr. J. Christie, engineer and manager, Brighton, in his contribution to the discussion on Mr. G. Porter's (engineer and manager, Worthing) paper on "The Heavy-oil Engine and its Application in Electricity Supply Undertakings" (Electrical Review, June 21st, p. 1121) at the I.M.E.A. Conference at Torquay this year. His idea is that oil engines, when they become disused as the result of smaller generating stations shutting down to give place to bulk supplies on grounds of economy, should be used for load-development purposes in the scattered districts. The idea of establishing temporary stations for development work is not altogether new. A recent notable example is the oil-engine stations installed at Haifa, Jaffa, and Tiberias in Palestine for the sole purpose of encouraging the growth of load preparatory to the extension of the new hydro-electric scheme (Electrical Review, May 3rd, 1929, p. 773). The scheme permits of the most essential requirement—low capital cost.

Cases have been made out for the small isolated heavy-oil-engine station, showing that the proposition for turning it over to a bulk supply, and in turn to the "grid," is uneconomical and unpractical. Further thought, we suggest, enlightens the engineer to grasping the essential fact that as his load and station grow, so he approaches the line of demarcation between the small station and the bulk supply—an argument clearly for the necessity of load development prior to embracement of the scattered area by the national system.

To conclude, there is one very important difference between the establishment of the small station or centre to-day and that of a generation ago. Now authorities must get away from the idea of lighting only. Local industry must be tackled with energy and enterprise, and above all domestic load must be regarded as the key-note to success.

Let the supply centres be established with confidence; let the Electrical Development Association, the Electrical Association for Women, and similar organisations carry on their good work in the wider field, and the national scheme will fall into line with its desired expansion as the natural order of things arising from enterprise and development.

The Synchronising Forces in a Motor-convertor.

In the following notes the way in which the forces act is developed from first principles in a purely physical and non-mathematical way.

By T. S. ANDREW, A.M.I.E.E.

STABILITY in any synchronous machine is inherently dependent upon its synchronous forces. A motor-convertor is usually described as consisting of an induction motor and a d.c. generator coupled together mechanically and by certain interconnections between the rotor and armature windings. In a machine with the same number of pairs of poles at both the a.c and d.c. ends, the armature and rotor when in synchronism rotate at half the speed of the rotating field set up by the currents in the stator, *i.e.*, at 50 per cent. slip, and when put on load the transference of power from the rotor to the armature is half electrical and half mechanical. It would, therefore, be more accurate to describe a motor-convertor as half induction motor and half rotary-convertor. When a motor-convertor is running in synchronism at no load, neglecting losses, there is no interchange of power between the ends. The word "power" is used advisedly instead of "current," as wattless leading or lagging current may flow according to whether the field on the d.c. end is strong or weak. The reasons for this are described later. As no power flows when the machine is in synchronism, it follows that the e.m.f.'s induced in the rotor must be of the same frequency as the e.m.f.'s generated in the armature, and also that these e.m.f.'s must be in phase opposition.

As an example, a machine with two pairs of poles at both the a.c. and d.c. ends will be considered. If the frequency of the supply is 50 cycles, then the r.p.m. of the rotating field set up by the stator currents is given by: r.p.m. = frequency × 60/pairs of poles = 50 × 60/2 = 1,500.

Since it is the induced e.m.f.'s in the rotor that must be in synchronism with the generated e.m.f.'s in the armature, it is necessary to know how the frequencies of these e.m.f.'s vary with the speed. With the rotor at rest, the speed of the rotating field induced in the rotor must be the same as that set up in the stator (in the example under consideration it will be 1,500 r.p.m.), and the frequency of the e.m.f.'s generated in the rotor by this rotating field will be 50. The rotor speeds up in the same direction as the field created by the stator currents rotates, so that the speed of the rotating field on the rotor relative to the rotor decreases, and the frequency of the e.m.f.'s induced in the rotor decreases. The sum of the speed of the rotating field on the rotor and the speed of rotation of the rotor is at all times equal to the speed of the rotating field in the stator. If the rotor were to turn at the same speed as the rotating field in the stator, *i.e.*, at 1,500 r.p.m., there would be no rotating field on the rotor and therefore no e.m.f.'s would be induced in the rotor windings.

Considering the d.c. end in the same way, the frequency of the e.m.f.'s generated in the armature varies directly with the speed. Since the field poles are stationary, the speed of the rotating field on the armature must be the same as the speed of rotation. At standstill there would be no rotating field, and at a speed of 1,500 r.p.m. the speed of the rotating field would be 1,500 r.p.m. The frequency of the e.m.f.'s generated within the armature would be zero at standstill, and 50 at 1,500 r.p.m. Plotting the curves for the frequency and speed of rotating field against the speed of rotation for both the a.c. and d.c. ends, fig. 1, it is seen that the speeds of rotating fields and the frequencies are the same in both ends of the machine when the rotating parts are turning at 750 r.p.m.

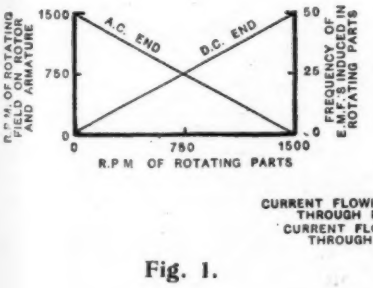


Fig. 1.

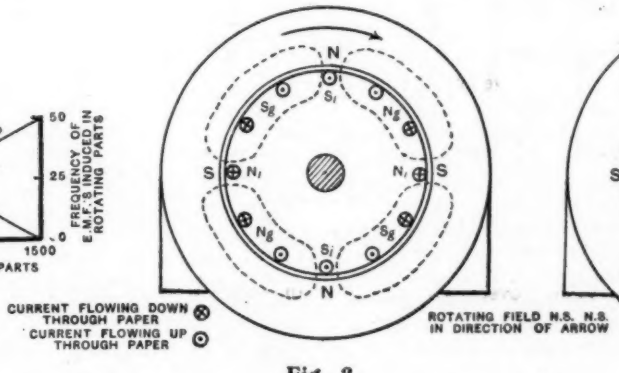


Fig. 2.

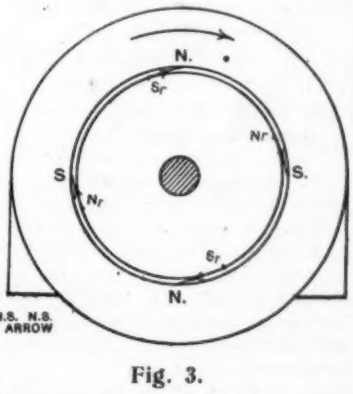


Fig. 3.

The rotating field on the armature and, therefore, the phase rotation of the e.m.f.'s generated within the armature windings, are in the opposite direction to the rotation of the armature. If the connections between the rotor and armature are arranged so that consecutive equi-distant tappings taken off the rotor in a clockwise direction are connected counter clockwise to a similar number of consecutive equi-distant points on the armature (looking at the same end of the shaft in each case), then the phase rotation of the e.m.f.'s at the junction of the interconnections from the rotor with the tapping points on the armature will be in the same direction. At 750 r.p.m. the frequencies are equal, and if the e.m.f.'s are equal, no current will flow along the interconnections.

It is obvious that the state of e.m.f. balance between the two ends of the machine will be upset if the machine is not in synchronism, and that currents leading,

lagging or in opposition to the e.m.f.'s induced in either end of the machine will flow in the windings, due to the resultant e.m.f. of the two ends of the machine. The phase relationship between the currents and the e.m.f.'s will affect the torque produced by the a.c. end and the load on the d.c. end, as the following reasoning will show.

(1) *The A.C. End.*

Continuing with the case of the machine with two pairs of poles at each end, fig. 2 represents an instantaneous condition. The magnetic circuit of each pair of poles is completed through the rotor laminations, as indicated by the dotted lines. Each north pole N on the stator will induce a south pole S_i on the rotor immediately opposite, and each south pole S on the stator will similarly induce a north pole N_i on the rotor. Since the rotating flux cuts the rotor windings, e.m.f.'s will be generated in the windings and currents may flow. Assuming that currents do flow, and that they are completely in phase with the induced e.m.f.'s, *i.e.*, at unity power factor, it will be found on applying Fleming's right hand rule that the direction of flow of the currents is as indicated in fig. 2. These currents will magnetise the iron on the rotor and form poles N_g, S_g, N_g and S_g midway between the induced poles N_i, S_i, N_i and S_i. Each pair of like poles on the rotor will have a resultant, N_R, S_R, N_R and S_R, which will lag behind and be of opposite polarity to the poles on the stator. These, unlike poles, attract one another, and set up the torque which causes the rotor to turn. Fig. 3 illustrates this condition. Considering the effect on the torque of currents flowing in opposition to the induced e.m.f.'s, it is obvious that the poles generated on the rotor by the currents in the rotor will be of opposite polarity to those shown in fig. 4, which represents the case of unity power factor. This condition is shown in fig. 5, from which it is seen that the resultant poles on the rotor interact with the rotating poles on the stator, and set up a negative torque which tends to reduce the rotor speed.

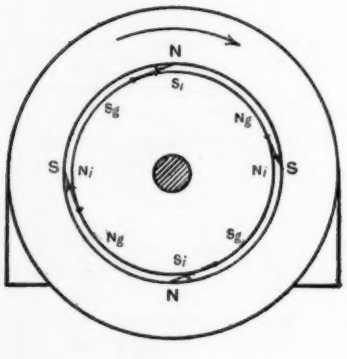


Fig. 4.

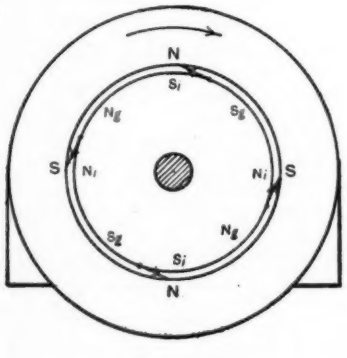


Fig. 5.

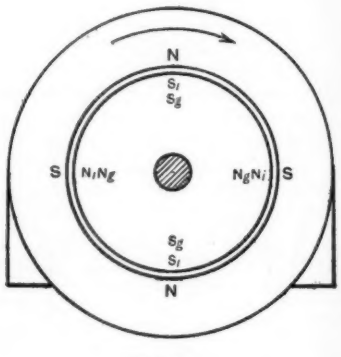


Fig. 6.

From the above investigations into the effects on the torque of currents flowing in the windings in phase with, and in opposition to, the induced rotor e.m.f.'s it can be stated that—

(*a*) Currents flowing in the windings of the machine in phase with the e.m.f.'s induced in the rotor increase the torque and tend to increase the speed of the machine.

(*b*) Currents flowing in the windings of the machine in opposition to the induced e.m.f.'s create a negative torque and tend to decrease the speed of the machine.

The condition when the rotor currents lag 90 deg. behind the induced e.m.f.'s is not essential for investigating the synchronising forces, but as it has considerable interest from the point of view of starting, it will be considered here. In this case the poles N_g, S_g, N_g and S_g, due to the magnetisation of the rotor by the rotor currents, will occur 90 electrical degrees later than in the case of unity power factor, and therefore the resultant poles on the rotor, N_R, S_R, N_R and S_R, will be immediately under the poles S, N, S and N on the stator, as shown in fig. 6. The forces of attraction between the unlike poles are then radial, and there will be no torque. The inclusion of a resistance in series with the rotor windings during starting is explained by the foregoing. When a.c. power is applied to the stator of a motor-convertor, the current in the rotor when at rest is limited only by the impedance of the rotor circuits and, but for the starting resistance, these circuits would be almost wholly reactive. In addition to improving the power factor and, therefore, the torque of the machine, the resistance also limits the starting current. There is, however, a certain value of resistance which will give maximum starting torque. If the resistance is increased above this value, the induced rotor poles, although moved to a more favourable position for the production of torque, are so decreased in strength that the torque is reduced.

(2) *The D.C. End.*

In the previous section the effect on the torque of currents in phase with and in opposition to the e.m.f.'s in the a.c. end was considered. The same consideration will now be given to currents flowing in phase with, and in opposition to, the e.m.f.'s generated in the d.c. end. In this case the armature is being rotated in a stationary field, and consequently the poles induced in the iron of the armature rotate round the armature in the opposite direction to the rotation of the armature. By applying Fleming's right-hand rule it is seen that, with currents flowing in the armature windings in phase with the induced e.m.f.'s, the direction of these currents are as shown in fig. 7. The poles N_g, S_g, N_g and S_g due to these currents are of opposite polarity to, and in advance of, the field poles. The resultant north poles N_R on the armature will be between N_i and N_g, and the resultant south poles S_R will be between S_i and S_g. The forces of attraction between these resultant poles on the armature and the stationary field poles are in the opposite direction to the rotation of the armature, and therefore will tend to lower the speed of the machine. By following the same line of argument it can be shown that with currents flowing in the armature windings in opposition to the generated e.m.f.'s, the forces of attraction between the field poles and the resultant poles on the armature are in the same direction as the rotation of the armature, as shown in fig. 8, and therefore tend to increase the speed of the machine.

From the above investigations of the effect of armature currents on the torque, the following statements can be made:—

(*a*) Currents flowing in the machine windings in phase with the e.m.f.'s generated in the armature set up a negative torque, and so tend to reduce the speed of the machine.

(*b*) Currents flowing in the machine windings in opposition to the e.m.f.'s generated in the armature increase the torque, and so tend to increase the speed of the machine.

In the following section the direction and effect of currents flowing in the windings of a machine will be investigated by means of simple vector diagrams for the following three conditions:—

(i) The machine in synchronism.

(ii) The machine tending to increase in speed from synchronism.

(iii) The machine tending to fall in speed from synchronism.

(1) *The Machine in Synchronism.*

In fig. 9 the simple voltage vector diagrams are shown for three conditions.

In (*a*) the voltage v_d between the tapping points on the armature is equal and opposed to the voltage v_a between the interconnections from the rotor. With this condition the resultant voltage of v_a and v_d is zero, and therefore no current flows through the interconnections between the armature and the rotor.

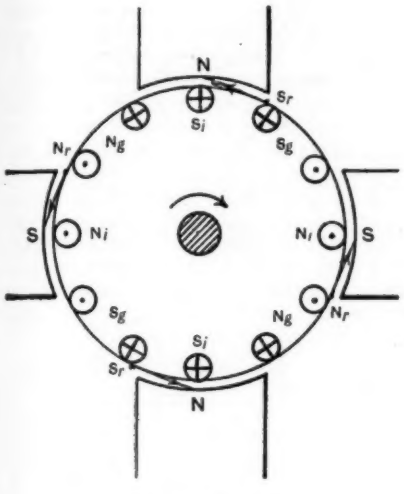


Fig. 7.

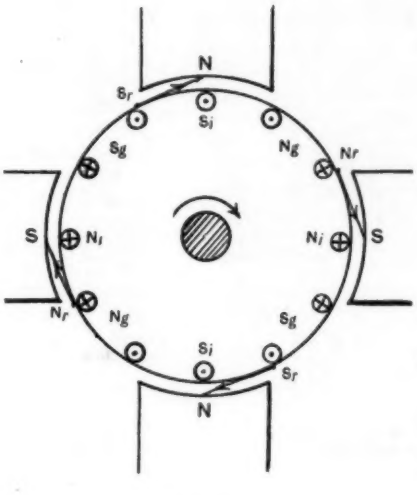


Fig. 8.

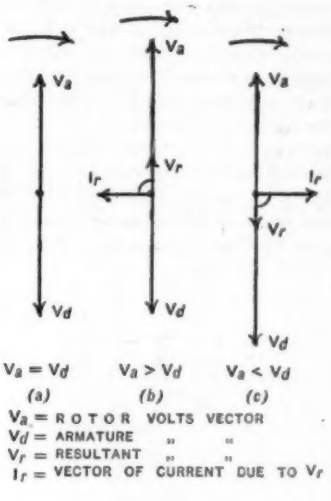


Fig. 9.

In (*b*) v_d is in opposition to, but less than, v_a, due to a weak d.c. field. v_a and v_d will, therefore, have a resultant voltage v_r in phase with v_a, and this resultant voltage will cause a current i_r to flow in the interconnections between the two ends of the machine which, owing to the high reactance and low resistance of the windings, will lag nearly 90 electrical degrees behind v_r.

In (*c*) v_d is greater than v_a, due to a strong d.c. field. The resultant voltage v_r of v_a and v_d will in this case be in phase with v_d and will, as in (*b*), cause a current i_r to flow in the interconnections which will lag nearly 90 electrical degrees behind v_r.

In (*b*) i_r lags 90 deg. (approx.) behind v_a. In (*c*) i_r leads 90 deg. (approx.) in advance of v_a. In each case this current i_r, by transformer effect, reacts on the stator windings and causes currents to flow which affect the power factor of the current taken from the system; but for the purpose of these notes it is not necessary to investigate the matter further.

(2) *The Machine Tending to Increase in Speed Above Synchronism.*

In fig. 10 a simple voltage vector diagram is shown for the condition when the machine is slightly in advance of synchronism. The a.c. voltage vector v_a tends to retard from phase opposition, and the d.c. voltage vector v_d tends to advance from the phase opposition. The resultant voltage v_r of these two vectors causes a current i_r to circulate in the windings, lagging nearly 90 deg. behind v_r. This current i_r has a large component in opposition to the e.m.f.'s induced in the rotor (*i.e.*, in opposition to v_a) and, therefore, in phase with the e.m.f.'s generated in the armature (*i.e.*, in phase with v_d). It has already been shown that the torque is reduced if either of the above conditions is satisfied. The tendency is, therefore, for the current i_r to pull the machine back to synchronism.

(3) *The Machine Tending to Fall in Speed from Synchronism.*

The simple voltage vector diagram is shown in fig. 11 for the case when the machine is slightly below synchronism. The a.c. volts vector v_a tends to advance from phase opposition, and the d.c. volts vector v_d tends to retard from phase opposition. Again, the resultant voltage v_r of these two vectors causes a lagging current i_r to circulate in the windings. This current i_r has a large component in phase with the e.m.f.s induced in the rotor (*i.e.*, in phase with v_a) and in opposition to the e.m.f.s generated in the armature (*i.e.*, in opposition to v_d). It has already been shown that if either of the above conditions is satisfied, the torque is increased. The machine therefore tends to speed up and fall into step.

Whereas in the case of two or more alternators running in parallel, any given angular (electrical) displacement of one alternator from synchronism causes an equal angular displacement of the voltage vectors from phase opposition, the angular displacement of the vectors in a motor convertor is twice that of the rotating parts when any departure from synchronism takes place, owing to the fact that the frequencies in the a.c. and d.c. ends both vary in opposite directions. Thus large synchronising currents flow for small departures from synchronism. This accounts for the inherent stability of the motor convertor.

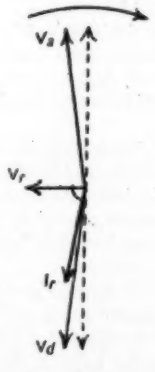


Fig. 10.

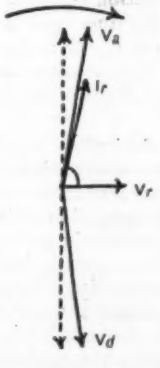


Fig. 11.

The author's thanks are due to Mr. D. Kingsbury for his helpful suggestions when compiling these notes.

Long-distance Telephone Cables.

How and Why They are Placed Underground.

By A. ENGELHARDT, D.Ph., and H. COBDEN TURNER, M.I.E.E.

(*Concluded from page* 189.)

APART from the application of high vacuum valve repeaters, the first two instalments of this article outlined the present state of the knowledge and practice which renders it possible to extend telephone circuits over the whole world. The functioning of the high-vacuum valve repeaters has been described so often that it is not proposed to discuss it here.

The ordinary duplex intermediate repeaters for two-wire working (see fig. 15) can be used for circuits in

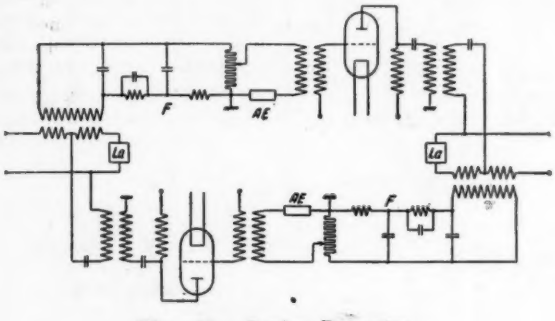


Fig. 15.—2-wire Repeater.

which the maximum attenuation (b) is not less than 7, and they amplify the speech currents in both directions without causing any feed-back coupling or echoes.

To do this the amplified current is passed in opposite directions through the two similar windings of a hybrid coil, which will not be magnetised as long as the two partial circuits have the same impedance for all the amplified frequencies.

For this reason impedance of the artificial lines L_a should vary with the frequency in the same manner as does the impedance of the trunk lines.

A curve showing the variation in impedance with frequency of a coil-loaded line, commencing with a half loading section, is given in fig. 16.

Artificial lines have now been designed which simulate accurately the variation in the average impedance for the most important frequency range, but the simulation is not absolutely correct for deviations from the average value.

These deviations are due to irregularities in the inductance and capacity of the individual loading sections along the route. We can easily keep the former within ± 1.5 per cent., but it is important that this uniformity shall be constantly maintained, and so it is imperative to use stable coils with dust iron cores.

The production of a cable with a sufficiently uniform mutual capacity was not an easy matter and was only achieved after much laborious experimental research.

Nowadays the variation can be kept within ± 4 per cent. of each loading-coil section and in special cases within even closer limits than that. By inserting a single two-wire intermediate repeater in such a uniform cable system, one could theoretically obtain a minimum amplification $s=3$. Near the cut-off frequency the deviations from the average of the impedance frequency curves of coil-loaded lines become very great, and so one prefers to cut out the frequencies of less importance to speech quality by inserting low-pass filters in the feeding-back circuit of the repeaters (F in fig. 15).

Unfortunately, conditions become less favourable when several amplifiers are connected in series. It is impossible entirely to prevent fluctuations in the impedance curves, which cause minute feed-back coupling currents for the frequencies corresponding to the peaks. The currents thus sent back into the line add themselves to or subtract themselves from the speech currents they encounter, and the action is as though the amplifier had an impedance which fluctuated with the frequency. Such fluctuations add themselves to the electrical irregularities of the preceding repeater sections and thus actually increase them. This difficulty becomes greater as the number of amplifiers is increased and so limits the permissible amount of amplification. Actually not more than four two-wire intermediate amplifiers are generally used in series, and the attenuation of the repeater sections should not exceed $b=1.4$ (see later); that is to say, the total attenuation does not exceed $b=7$, which with a 1.4 mm. conductor (0.36 in. diameter) would give a 450-mile cable as a maximum.

For greater distances it is expedient to adopt single-way working for the repeaters, that is the four-wire system, which uses a separate circuit for speaking in each direction (see the upper part of fig. 17). This arrangement was suggested by van Kesteren in the year 1912 (Dutch patent 247 of 19/12/1912). Back feeding does not set in until the total amplification in the back feeding circuits exceeds the total attenuation, which means that it is possible almost entirely to diminish attenuation from the four-wire circuit. Ohnesorge in 1915 (German patent 301772 of 16/12/1915) and Campbell (U.S.A. patent 1352786 of 17/1/1916) a little later, inde-

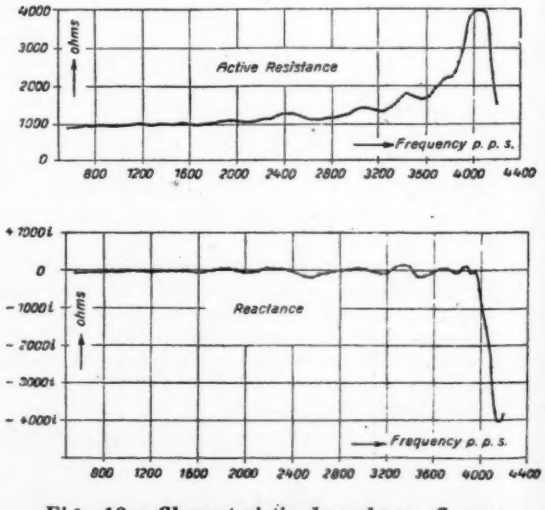


Fig. 16.—Characteristic Impedance Curves.

pendently of each other, found a still better solution. They proposed to connect up the two-wire circuits (subscribers' lines or further trunk lines) over bridging or differential circuits and to simulate them with artificial lines L_a (see lower part of fig. 17). The conditions, similar to those met with two-wire intermediate amplifiers, render it possible to obtain an excess of amplification, the only limit to which is the accuracy with which

the artificial lines balance the two-wire circuits further on. The amplification actually attainable is about $b = 2.8$ for each amplifier when not using any multi-valve circuits.

It is particularly important to obtain complete absence of cross talk between conversations taking place in opposite directions over the two independent speaking circuits of the four-wire system, because at the point in the one where the energy of speech has been amplified,

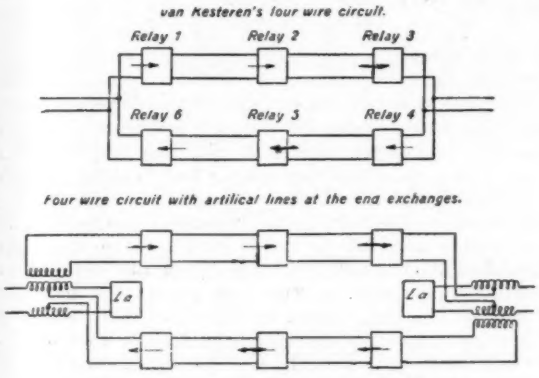


Fig. 17.—Van Kesteren 4-wire Circuits.

the energy of the other is just about to be amplified and is at its weakest, so the disturbance factor is greatest.

The conditions are worse by an amount $\delta b = 1.4$ than for two-wire working with two-wire intermediate amplifiers. In both cases the disturbing currents are being amplified, and accumulate in the individual repeater sections, provided that they are in phase, which is in fact the case for the majority of the frequencies.

By skilfully arranging the four-wire speaking circuits in the cable itself, it is possible to obtain cross talk attenuation of $b > 11$ between conversations in opposite directions, hence the question of cross talk due to the inserted amplifiers does not influence even the longest circuits.

Both the resistance and the capacity of a cable vary with the temperature, and hence the attenuation follows

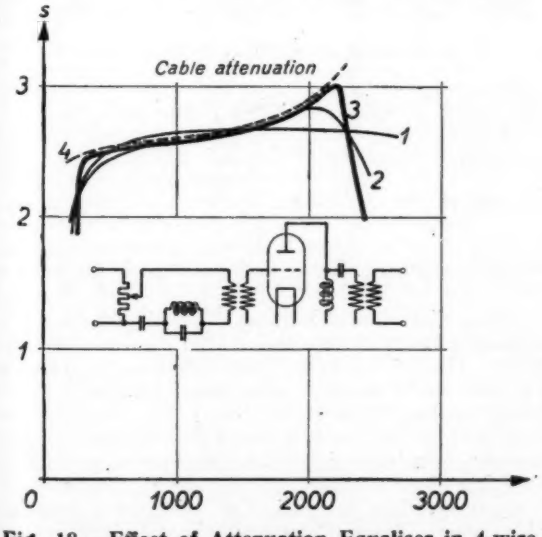


Fig. 18.—Effect of Attenuation Equaliser in 4-wire Repeater.

suit. The temperature coefficient for the attenuation is about 4.3×10^{-3} for every 1 deg. C. in conductors of 0.9 mm. diameter. On a summer day the temperature may easily fluctuate 25 deg. C., and in the case of an aerial cable this change of temperature produces its immediate effect. Hence for a cable 2,000 km. (1,250 miles) long having an attenuation $b = 37$, the attenuation may vary $\delta b = 4$; that is to say, the energy of the incoming speech may sink to a 3,000th part of its strength between early morning and midday. This clearly makes it impossible to give a reliable service.

In America the Western Electric Co. provides the long overhead cable routes with automatic temperature regulating devices. The cable contains pilot wires, which at each third amplifier are caused to form a branch of a Wheatstone bridge. The equalising current through the diagonals of the bridge changes its direction in accordance with the rise and fall of the temperature of the cable, and controls relays which correspondingly increase or diminish the degree of amplification.

The conditions are much better in the underground cables used in Europe. At a depth of 2½ ft. the temperature of the earth never varies more than 2 deg. C. during the 24 hours of the day, which corresponds to a maximum diurnal variation in the attenuation $\delta b = 0.35$ in a cable 2,000 km. (1,250 miles) long, and so can be ignored.

Echoes.—Another difficulty met with in long-distance circuits is the so-called echo effect. At certain frequencies the impedance of the two-wire lines connected to the four-wire lines are not equal to those of the artificial lines simulating them. This gives rise to feed-back currents, which after a certain lapse of time reach the speaker's ear. The cycle repeats itself, but the second and succeeding echo effects are of little importance owing to their progressive attenuation. The propagation speed is $v = 1/\sqrt{LC}$, hence the time taken by the echo to be propagated is $t = 2l\sqrt{LC}$, where l is the length of the line. For

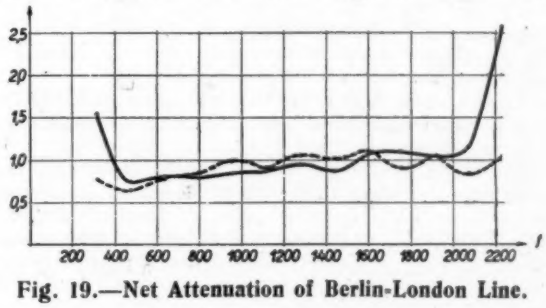


Fig. 19.—Net Attenuation of Berlin-London Line.

coil-loaded cables we can substitute the approximate equation $t = 2l/\pi s f_0$ (s = length of the loaded section and f_0 = the cut-off frequency). For a 4,500-km. long standard loaded cable having a cut-off frequency of 2,850 p.p.s., we get an interval of half a second between the transmission of speech and the arrival of the first echo. The interval is about 1/10 sec. for a line only 650 miles long. Even extra light loading (see later) with a cut-off frequency of about 5,600 only diminishes propagation time to about ¼ sec. for 2,900 miles and to 1/18 sec. for 650 miles.

As the average duration of a vowel is 1/10 sec. and that of a consonant is 1/20 sec., these echoes would be very troublesome. This has led to the introduction of "echo suppressers," pieces of apparatus whereby a small part of the speech energy flowing in one direction is used to throw out of action the repeater for the other direction, the object being thus to bar the path of any echoes.

The very small current used for this purpose is first amplified, then rectified, and then operates a relay, which short circuits the paths of the echo currents or displaces the grid voltage of the repeater for the return direction, thus making it inoperative (Robinson & Chamneys patent No. 225603). In two-wire working every repeater is a source of echo, but the echo is not troublesome because the propagation times are shorter.

Distortion.—Line distortion was a further difficulty which had to be overcome before the long-distance telephone became serviceable.

The attenuation of a loaded line rises slowly as the frequency first increases and then very rapidly when approaching the cut-off frequency. This was not troublesome in cables less than 125 miles long, because the difference in loudness is only small ($\delta b = 1$) for the frequencies from 550 to 1,900. But for greater lengths, attained by

inserting several repeaters in the circuit, it is necessary to adopt special means to keep the speech distortion within certain limits. Curve 4 in fig. 18 shows how the attenuation of a repeater section depends on the frequency. As is well known, the input repeating coils in the grid circuit of the repeaters are highly inductive, having many thousand turns of very fine wire, and their characteristic capacity turns them into resonant circuits having a maximum primary impedance at the resonance frequency.

The corresponding amplification of a single-valve

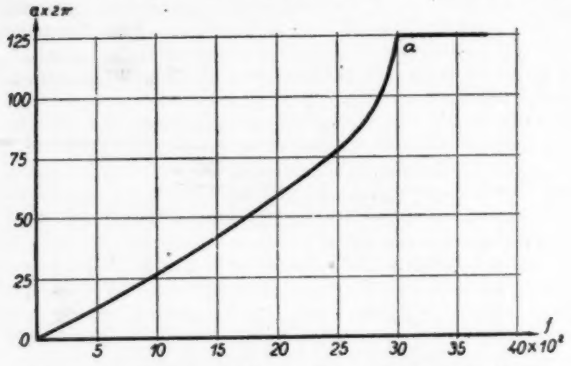


Fig. 20.—Phase Angle of Normally-loaded Line 500 km. Long.

amplifier for four-wire working is given by curve 1; the maximum amplification occurs when the input repeater has its resonance frequency $f=1{,}600$.

Taking advantage of the fact that the attenuation as well as the amplification rise in the range of frequencies with which we are concerned, it is only necessary to adapt the amplification curve 1 more exactly to the attenuation curve 4 by means of auxiliary devices at the repeater. The result is shown by curve 3. Thereby an amplification $s=2.8$ can be obtained for the average speech frequency $f=800$, when using single-valve repeaters. The additional apparatus is shown in fig. 15 (AE) and fig. 18, connected in series with the input repeater. It consists of a capacity connected in series with a resonant circuit consisting of an inductance and a capacity with an ohmic resistance (not shown) connected in parallel. Fig. 19 shows the success achieved in both directions with the 850-mile Berlin-London cable route employing four-wire repeaters. The net attenuation curve, as will be seen, is practically flat for all the important frequencies.

After overcoming the difficulties of the variation of the net transmission equivalent (b) with frequency as above described, it only remained to overcome the diffi-

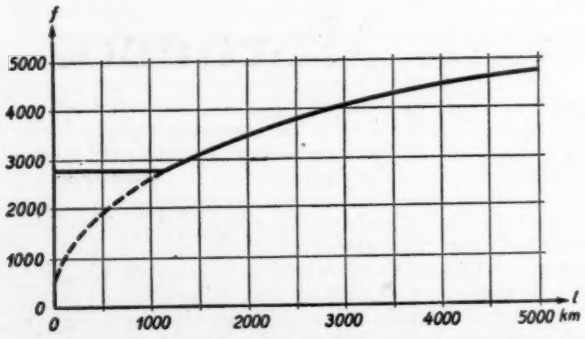


Fig. 21.—Limit of Good Transmission as Function of Cut-off Frequency.

culty due to the variations of the phase angle with the frequency. By this is understood the difference between the phase angles at the sending and receiving ends of a wave propagation over the line. Thus a, the phase angle, has the value 2π for one wave-length. Every oscillation covers one wave-length in the time $1/f=2\pi/\omega$. Hence for any desired length of line the propagation time of a wave has the value $t_o=a/\omega$. For homogeneous lines of high inductance a is approximately proportional to the frequency. The propagation times for the waves of all frequencies thus have the same value t_o. All oscillations arrive at the receiving end with the same relative phase conditions with which they entered the line. No distorting transient phenomena occur at the receiving end. For coil-loaded lines this holds good only at the lower frequencies, which are far enough removed from the cut-off frequency. The curve a in fig. 20 shows how the phase angle increases with the frequency in a 300-mile standard coil-loaded cable, and it will be seen that for the higher frequencies up to the cut-off frequency the propagation times are longer. The lower frequencies of any incoming signal are consequently received first and the higher frequencies arrive later. The duration of these transient phenomena increases with the length of the line. The short consonants are the first to suffer and the intelligibility of the whole is affected. In other words, the longer the loaded line the narrower is the band of frequencies not noticeably affected by the transient phenomena. At first sight there appears to be no alternative but to extend the cut-off frequency; that is to say, to use less loading. It can be calculated that the cut-off frequency must rise nearly proportionally to the cube root of the length of the line. The formula actually is $s \cdot f_o^3/l=c$, where s is the length of a loading section, l the length of the line, and c is a factor ascertained by experience to give clearness of speech, *i.e.*, when transient phenomena do not exceed the time of 20 milliseconds. The value of c is $4 \cdot 10^7$. Thus we arrive at the cut off frequencies given in fig. 21 which are the minima for the various lengths of line. The cut off frequency now used, $f=2{,}800$, is therefore good enough up to 1,200 km. (750

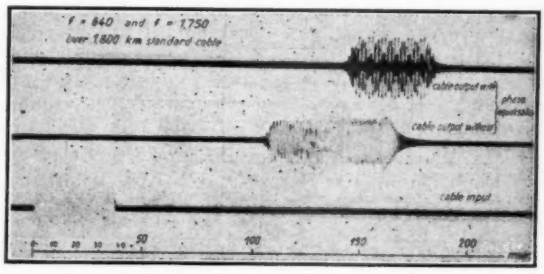


Fig. 22.—Effect of Phase Equalisation.

miles), but it should be generally used only up to 625 miles, and so four-wire working has come to be used for normally-loaded cables having a length of from 450 to 625 miles. For the greatest distance likely to be covered in Europe, namely, 2,800 miles, it would suffice to use a cut-off frequency of 4,600 with four-wire working, but to be quite on the safe side the authorities have decided to adopt a lighter loading giving a cut-off frequency of 5,600.

Kupfmuller (now of Dantzig University, formerly of Siemens & Halske) at the end of 1923 suggested (German patent 452,286 of 5/10/1924) inserting at repeater stations, special elements called phase equalisers, which, acting contrary to the loaded line, have a brake or slowing down action on the lower frequencies. In this manner it is theoretically possible to obtain the same resulting phase propagation time for all the important frequencies, thus preventing all disturbing transient phenomena. Practical tests of this procedure are now being carried out on the German long-distance cable system. Fig. 22 shows the result obtained on a length of 1,100 miles of coil-loaded standard cable (cut-off frequency $f_o=2{,}700$). Two combined signals of $f=640$ and $f=1{,}700$ were put on the line (see lower part of fig. 22). Without inserting phase equalisers the low-frequency signal arrives before the high-frequency signal at the distant end of the circuit, the beginning and end of the signals being distorted by transient effects (middle of fig. 22). After inserting the equalisers we receive a signal at the distant end of nearly the same shape as the

original (upper part of fig. 22). The curves in fig. 23 show another example: the lower curve, giving the phase propagation time in an uncompensated cable of 1,900 miles, should be compared with the top curve showing the result obtained by inserting the selected auxiliary elements. The success thus reached makes it certain that these equalisers will be adopted, so that even for long-

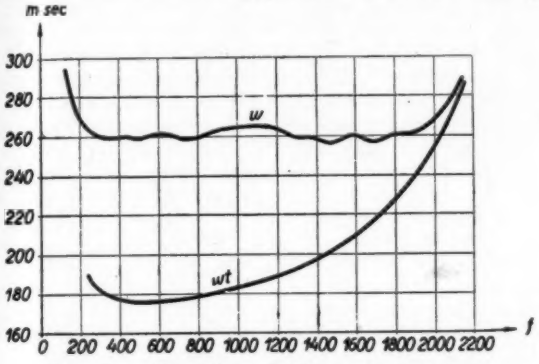


Fig. 23.—Duration of Phase Propagation.

distance working it will be possible to retain the standard loading, which will be very economical and convenient.

From the above one can state what kind of cable would be used for the various distances:—

Up to 50 miles 2-wire working 0.9 mm. conductor standard loading.

Up to 450 miles 2-wire working 1.4 mm. conductor standard loading.

450-625 miles 4-wire working 0.9 mm. conductor standard loading.

Over 625 miles 4-wire working 0.9 mm. conductor light loading.

The distance between repeaters is 87 miles for the 1.4 mm. conductors, which corresponds to an attenuation of $b=1.4$ per two-wire repeater section, and it is likewise 87 miles ($b=2.8$) for 0.9 mm. conductors with four-wire working. The mileage limit attainable is determined by the largest number of repeaters that can be connected in series. So far we have had no experience for determining that number. It partly depends on the reliability of the service and partly on the efficiency of the staff at the repeater stations. Assuming, for example, that the maximum number of amplifiers is 20, we could use for distances up to 870 miles conductors 0.9 mm. thick with repeater stations 43 miles apart inserted between the main repeater stations; while up to 1,750 miles conductors 1.4 mm. could be used with amplifiers 87 miles apart. Although the permissible amplification $s=2.8$ would permit the repeater sections to be rather longer, it will be more convenient to locate the amplifiers for the comparatively small number of international trunk lines in the repeater stations provided for two-wire circuits. For distances exceeding 2,800 km. there is at present no alternative but to increase the cross section of the conductors, as the danger of cross talk prevents the amplification of the individual four-wire repeaters being appreciably increased. The maximum distance in Europe, namely, 2,800 miles, with 17 amplifiers, would require conductors of 2 mm. in order to be on the safe side; but the above-mentioned means for diminishing the phase distortion will render it possible to treble the present range of transmission.

It will not be out of place to mention the present-day

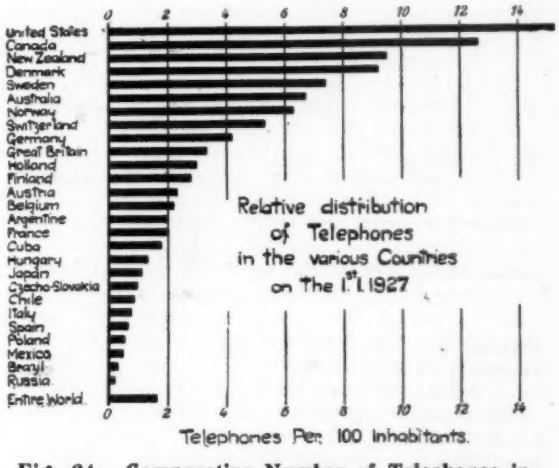


Fig. 24.—Comparative Number of Telephones in various Countries.

charges for a unit telephone trunk call to several places in Europe:—

	s.	d.		s.	d.
London to Berlin ...	11	10	Berlin to Paris ...	7	7
Berlin to Brussels ...	5	5	Berlin to Posen ...	2	10
Berlin to Budapest ...	5	3	Berlin to Prague ...	2	6
Berlin to Copenhagen	5	0	Berlin to Riga ...	6	0
Berlin to Dantzig ...	2	9	Berlin to Rome ...	7	7
Berlin to The Hague	4	5	Berlin to Stockholm ..	5	0
Berlin to Innsbruck	4	6	Berlin to Switzerland	5	0
Berlin to Luxemburg	4	6	Berlin to Strasburg...	6	0
Berlin to Memel ...	5	3	Berlin to Vienna ...	4	0
Berlin to Oslo ...	5	6	Berlin to Warsaw ...	4	5

Fig. 24 indicates the comparative number of telephones in various countries.

Hydro-electricity in Morocco.

Important Large Development Schemes are in Progress.

By W. G. CASS.

AMONG the important public works and improvements contemplated in the new Moroccan loan of over 800,000,000 francs recently issued by the French Government, is a fairly considerable programme of electrical power plant development and the utilisation of latent water-power resources. With the exception of the Bas Sebou, most of the rivers in Morocco are not navigable and are unsuited for inland transport purposes, but they are well adapted for hydro-electric and irrigation work and are to this extent of great economic value in view of the fact that Morocco has no supplies of coal. A considerable amount of work has already been done in the direction of utilising potential water-power resources in Morocco; in fact, from the very earliest days of its coming under French control the French authorities have attempted to provide at least some of the principal towns with electricity derived from the available water power.

Among the first of such attempts was a concession granted to the Compagnie Fasi d'Electricité in 1911, to supply electric light to Fez. In 1915-16 the Société Marocaine de Distribution d'Eau, de Gaz et d'Electricité (S.M.D.) obtained powers to supply Casa Blanca and Rabat with electric power rendered available by surplus power from steam plants. The port authorities of Casa Blanca, for example, had three power sets of 250 h.p., which were not by any means run to full capacity, and the surplus power was available for electrical purposes. In 1918 there was a further extension of the electrical system and the S.M.D. installed Diesel plant of 2,300 h.p., and again in 1920 the same com-

pany obtained a further concession and installed two new sets of Diesel plant of 1,400 h.p. each. Similar power stations were also installed at Rabat, and new concessions were granted either to individuals or to companies in 1921 and the following years, *e.g.*, for Taza, Marrakech, Mazagan, and Saffi, but the urgency of the need for a far greater development of water-power resources than any hitherto attempted has now become apparent.

It was realised that a carefully planned and co-ordinated scheme of hydro-electric power development for the whole of Morocco was absolutely essential for the country's economic and industrial progress, in accordance with the ambitious schemes of the powerful French colonial party. There are in Morocco three rivers, the Moulouja, the Sebou, and the Oum er Rebia, of sufficient volume and permanancy to be useful for hydro-electric work. The chief difficulties were the carrying out of a complete survey of the river basins, especially at their source in the Atlas Mountain region, where the native tribes were still intractable and hostile. It was only in 1920 and thereafter in proportion as progress was made in the pacification of the hill tribes (a work not yet by any means completed) that any more or less complete study could be made of the available water powers, catchment areas, volumes of water at different seasons of the year, and so on. Such preliminary work was sufficiently far advanced in 1923 to justify the formation of a company, which was at first known as the Syndicat d'Études pour la Mise en Valeur des Forces Hydrauliques au Maroc, and was subsequently merged in the Soc. Anon. d'Energie Électrique du Maroc, with a capital of 10,000,000 francs. Among its principal aims is the supply of electric power to the railways, to the phosphate and other mines, and to urban lighting companies. It is hoped that the supply will soon be extended to rural districts and be available for pumping and irrigation work. More specifically the company was formed to (1) erect large hydro-electric power plant on the Oum er Rabia at Sidi Machou; (2) construct thermal stand-by plant at Casa Blanca; (3) erect high-voltage lines to link up the power stations at Casa Blanca, Rabat, Mazagan, and Marrakech with the railway lines to be electrified and with the phosphate mines; and (4) construct in the upper basin of the Oum er Rabia and its tributaries at suitable points one or more power stations of an aggregate capacity of from 15,000 to 20,000 kW, to be connected with the systems above named. It was stipulated at the time that the concession to the E.E.M. would involve further electrical development at a later date; in particular, the extension of the system from Kenitra to Meknes and Fez. This new line would be partially supplied with electricity from the central station using hydro-electric power derived from the barrage constructed on the Oued Beth.

These various works are being carried through as quickly as possible. The central power station at Casa Blanca (Roches Noires quarter) was completed in January, 1925, and the first 60,000-volt lines were in commission. The E.E.M., which had in September, 1924, bought the plant at Casa Blanca from the Soc. Maroc de Distribution, concluded contracts for the supply of electricity to the city of Casa Blanca; also a special agreement to supply 300,000 kWh monthly to the large cement works of the Soc. des Chaux et Ciments du Maroc. In May, 1925, it re-purchased from the S.M.D. its Salé works and now supplies electricity to that town and also to Rabat. In 1926 the electrification of the Casa Blanca-Rabat railway was completed, which work required special precautions and adjustments in view of the peculiar atmospheric conditions near the coast. Further railway electrification was successfully accomplished on the phosphate line between Casa Blanca and the Kourigha mines. Work on the new hydro-electric station at Sidi Machou was commenced in 1925 and will, it is hoped, be completed this year (1929). The sinking of the piles for the dam was finished in 1927. Notwithstanding the various delays to which the work was subjected (the military operations against Abdul Krim, for example, must have seriously interfered with any development of this sort), very satisfactory progress has been made. The 60,000-V line from Sidi-Machou to Sidi-el-Aidi, connecting the central hydro-electric station and the other (thermal) station at Roches Noires, is finished.

A preliminary survey for a power station in the upper basin of the Oum er Rabia has been commenced. The Soc. des Ports Marocains is co-operating with the E.E.M. to form an electricity supply company at Kenitra. Finally, a further survey is being made to investigate the possibilities of extending electricity service to rural districts. A 22,000-V line between Casa Blanca and Fedhala was completed in 1927, and the villages of Settat and Ber Rechid will be supplied by a similar scheme. It is hoped that this preliminary programme of rural electrification will be continued, and that electric light and power will be brought within the reach of many country districts in Morocco by the erection of several more hydro-electric stations, for it cannot be said that the water-powers of Morocco have as yet been utilised to anything like their full capacity.

Invention.

This article, which deals with the need for fostering and guiding the efforts of individual inventors, will be read with interest by most engineers, besides being a guide to the younger novices.

By A. PAGE, B.Sc., A.M.I.E.E., A.M.I.Mech.E.

TO engineer, or to invent, may, in a sense, be considered synonymous, as any engineering work, no matter how small, must be invented before it can be created. Nowadays an engineer does not follow his profession for the remuneration derived therefrom, as most other walks in life prove much more lucrative for less energy expended.

There is, however, a natural glamour about mechanics which appeals to youth, and, like a glistening web attracts a fly, it becomes extremely difficult to shake off once one has become entangled therein. To this reason, may I say alone, our profession owes its recruits, as they are surely not attributable to the gilded accounts of existing members. Neither does the inventor follow his calling for personal gain; he seems impelled by some unseen force. Some small incident, or imperfect contrivance, kindles his imagination, and, like a seed in the ground, it grows. It is particularly simple to trace backwards the thoughts of an inventor, but it is an entirely different matter to start from the known and discover the unknown. It needs weeks, months, and even years to do so. An inventor may have struggled manfully over a mountain of difficulties to within a yard of his destination, and actually for months have been before the gates of his solution, without as much as recognising the key in the lock with which to enter. This tantalising position gives him greater incentive than ever, as his natural instinct refuses to surrender at this stage. These are the periods in which mid-night oil and half-eaten meals play an important role, and probably the closer he strives after the required end, the further it appears to recede.

The inventor becomes so wrapped up in his reasonings that the last part is found, not during experiment, but

when his mind has drifted again into clear surroundings, such as a week-end at the coast would permit. Then he cannot return to town fast enough, and the train seems to stop at each way-side station just because he is anxious to put his latest theories to practical test; and afterwards he will say to himself: "Well, I was a fool not to see that before," and his friends will confirm the view by saying "There is nothing much in that. It is a natural deduction. I could probably have told you myself if you had asked me." Truly did Carlyle say: "Genius is, first of all, an infinite capacity for taking pains," as thoroughness leaves nothing to chance.

Having reached success, a sigh of relief is given that the great task is complete, but the greatest of men make mistakes, for the inventor's trials have only just commenced. With the first flush of victory he is anxious to confide in his closest friends, but the Patent Laws tell him to go to his agents. I have always great admiration for these gentlemen, as their patience and sufferance when attentively listening to many and varied hair-raising schemes is a matter for no small praise. At the same time, they give the novice valuable guidance, even if it is only by telling him the *intention* of the Patent Laws is to protect the inventor, but their *practical application* is the reverse.

With specification in hand, there *only* remains the finding of a suitable manufacturer, purchaser, or financier, and this is where the disappointments commence. Criticism comes fast and furious. The idea may be sound, but the design unsatisfactory from an operating, manufacturing, or artistic point of view. To be successful, an invention must first be required; secondly, be useful; thirdly, be a good prospective seller; and, lastly, be capable of being economically manufactured. Failure to qualify in any of these respects may render the best invention unmarketable. Of course, only the individual inventor is being considered, and not the one who has finance and manufacturing facilities readily to hand. Very often from the latter category can be traced an invention which is neither useful, nor readily manufactured, which even has very few features of novelty about it, but which is successfully marketed for no other reason than that the purchaser is courteous and does not wish to slight a business friend with whom he has more important dealings.

Now, supposing manufacture is commenced, there are a host of other matters to be attended to by someone, be it advertising, distributing, drafting literature, and, to be modern, arranging hire-purchase terms. Unless the inventor has decided to risk his all in the venture, the marketing and carrying to fruition of the idea must be entrusted to some other hands. Thereby enter agreements, licences, &c., which require skilful handling and wording if failure is not to result. One instance of this is that of a manufacturer acquiring a sole licence and then for some trivial reason failing to produce the goods, actually because they may displace others of his products, the production tools of which have not yet paid for themselves. Such, and many other similar, pitfalls beset the path of the inventor, and should his patent prove a success it will only stimulate other people towards circumventing it, or endeavouring to prove its invalidity by lack of novelty or priority. Then, if the patentee wishes to maintain his rights, he learns that his invention is not an invention unless his claims have been fought out in the law courts, which may cost £10,000 or more. It is therefore like playing with fireworks, and the best policy is to hand on the responsibility of maintaining the patent to someone else, being content even with a smaller sum and a retaining graduated royalty, if desired, so that, should the invention prove popular, the inventor will benefit correspondingly.

It is one matter to get out a useful invention, and a different matter to make it pay. In fact, greater genius is required to make it pay than to get it out. Too often we hear of great inventors who have died in poverty, and even the companies exploiting, or possessing, master patents frequently assess them at a nominal value of £1 in their balance sheets.

The position, therefore, of a private individual seeking fame may almost be described as hopeless. If he is an employé, his employer frequently endeavours to claim exclusive rights to all original ideas by wording the terms of his employment agreement accordingly. What justification has an employer for demanding this concession, any more than he should claim the flowers from his employe's garden which are tended in his spare time? Surely it is the speediest way of killing enterprise and co-operation. Conceding, however, that this obstacle is surmounted, a patent of any magnitude normally requires some preliminary experimenting and possibly research, which can hardly be conducted, or financed, by one who must also earn conjointly his livelihood. Hence the existence of associations, but, if they are approached for aid, they insist on having assigned to them the fruits of any discoveries, although they may nominally allow claims as to the state of knowledge before the application for assistance.

This certainly is not conducive to stimulating invention, and whilst the associations are doing admittedly good work, they seem to lack natural inventive inspiration, which can only come, not from the trained scientist, but from the gifted inventor whose efforts are directed by the scientist and manufacturer alike into the correct channels. At present our researchers appear to be labouring and stressing too greatly minor points, so that the only progress made is by a multitude of minor steps. The real inventor, if given the opportunity, would circumvent the major portion of this work by bringing to light fundamentlly new ideas, which would immediately throw open new lines of attack.

Indeed, surveying generally the field of engineering, there have been surprisingly few fundamental inventions in recent years. Over 100 years ago we were introduced to the science of steam power, but we are nevertheless still content to use it in the originally presented inefficient manner by still retaining condensers. A host of work has since been completed on the steam engine and turbine, and, whilst we dabble in researches on cut-off and blade angles, the inherent fault of the steam cycle never receives attention. There are many parallel instances connected with the generation and distribution of electricity, propulsion, aviation, wireless transmission, and such-like matters that require a thorough shaking up from their foundations and placing on new bases before we can ever hope to radically improve them. As there are so many workers thinking along the same lines, it is highly probable that the solution to problems will be found in the most unexpected quarters. A certain advantage would appear to be present if one reasoned in absolutely the reverse sense to the normal, as thereby one would be covering entirely untrodden ground, and the chances of discovering new methods would be distinctly more favourable than when following closely the beaten track of others.

Without being too pessimistic, whilst admitting that there are certain exceptions, it is safe to say that under present conditions the opportunities for the serious inventor are thwarted in their initial stages, and it entails an infinite amount of perseverance, luck, and forethought, before he can reach success. Even then relatively few inventors can claim to have made any financial gain from their work, and there are fewer inventions still which are maintained for their full term of years. At present neither the facilities for preliminary experimental work are available, nor ready capital for covering its cost, unless tangible results are forthcoming immediately, which, in the majority of cases, cannot always be guaranteed in advance. If we sincerely wish to maintain our position as a leader of nations, invention must remain one of our principal assets, whether it be creating new industries or otherwise, and if we are to possess inventions of outstanding merit, then different arrangements must be organised for fostering and guiding the efforts of individual inventors, to relieve them of the anxieties of initial finance, and to protect them from vultures only too eager to carry off the meat of their successes.

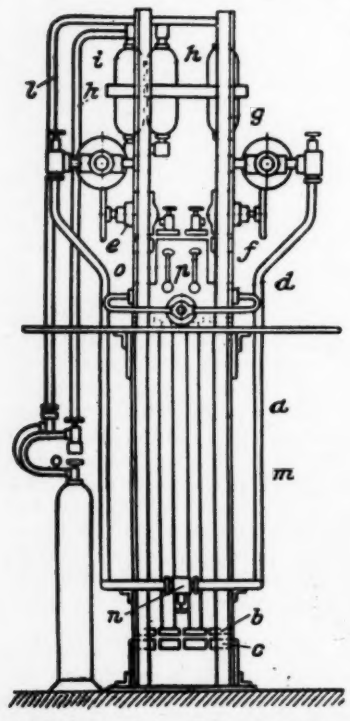
The Electrolysis of Water under Compression.

Developments Leading to the Cheap Production of Oxygen and Hydrogen at High Pressure.

By DR. A. SALMONY, Berlin.

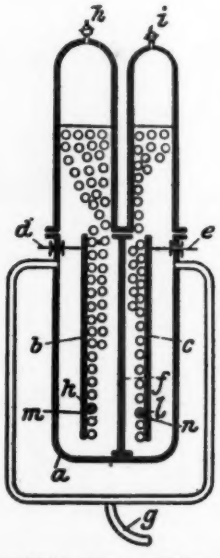
WATER electrolysis under compression produced by the accumulation of the decomposition gases themselves was first investigated in 1900. The decomposition proceeds in accordance with Faraday's law (quantity decomposed proportional to current), whilst the energy used depends on the voltage per cell and this again varies with the type of cell adopted.

Dr. I. E. Noeggerath (Fellow A.I.E.E.), of Berlin, decided to work in the direction of high compression without the use of compressors as this leads to great economy in space and plant. Initially two difficulties had, however, first to be overcome, namely, the selection of a suitable diaphragm to keep the two gases apart and avoid the production of an explosive mixture in spite of the high compression, also the provision of suitable containing chambers to withstand the action of strong alkaline solutions under high compression. Although these difficulties were eventually overcome fairly easily on a laboratory scale, they led to considerable trouble when large-scale production with many cells in series across ordinary supply voltages was involved. The maintenance of tight joints was one difficulty, whilst variations in the volume relations in the various chambers as the hydrogen and oxygen gases were drawn off also caused trouble. At first attempts were made to draw off the gases without any form of separating cell, but under the high pressures involved it was found difficult to keep the gases completely separate.



(a) Pressure pipe. (b) Current connections to electrode. (c) Cover. (d) Forging. (e) (f) Valves for the oxygen and hydrogen containers. (g) Oxygen container; (h) (i) hydrogen container; (k) (l) pipes to the gas cylinders; (m) equalising pipe; (n) water inlet; (o) (p) safety valves.

Fig. 1.—Noeggerath High-pressure Electrolyser, 150 Atmospheres.



(a) High-pressure container. (b) (c) Electrodes. (d) (e) Current connections. (f) Separating diaphragm. (g) Water supply. (h) (i) Cocks. (k) (l) Minute bubbles of gas in the nascent state. (m) (n) Rising gas bubbles.

Fig. 2.—Diagrammatic View of Electrolyser.

Finally, Noeggerath succeeded in developing an arrangement which could produce hydrogen and oxygen at pressures up to 150 atmospheres whilst at the same time taking up very little space.

This was after he had been experimenting for years on the subject, both in America and at the Berlin Technical High School. He worked with ordinary gas cylinders and pipes as the actual high-pressure cells. The one gas was produced at the surface of a nickel electrode and this was surrounded concentrically by the high-pressure cylinder, so that one gas could be drawn off centrally and the other at the outer periphery. An extremely elastic pressure equalisation prevents any mixing of the gases and any risk of dangerous pressure rises. The two electrolytic chambers are connected by an equalising branch of such dimensions that no interchange of electrolyte takes place in case of pressure differences. Fresh water is supplied automatically continuously so that the electrolyte, a 30 per cent. solution of caustic potash, remains unchanged (fig. 1).

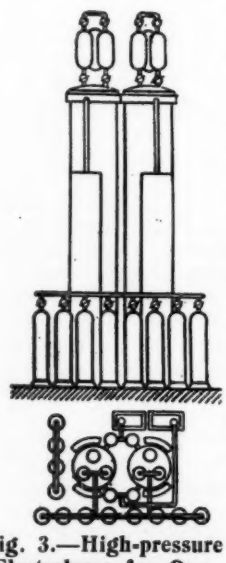


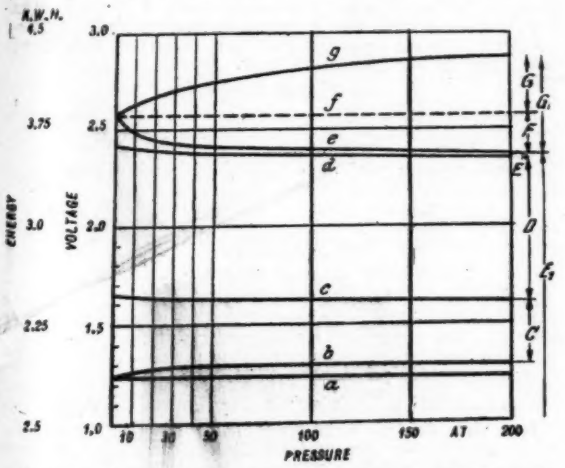
Fig. 3.—High-pressure Electrolyser for One Million Cubic Metres a Year at 440 Volts and 200 Atmospheres.

The actions in such a cell are explained by Noeggerath as follows:—Referring to fig. 2, which shows the arrangement diagrammatically, current is supplied at *d* and *e* to the two electrodes *b* and *c*, separated by the diaphragm *f*. The two cocks *h* and *i* are open at first. Electrolysis commences under atmospheric pressure, and this, after closing the cocks, gradually rises to a pressure of about 50 atmospheres. Minute gas bubbles *k* and *l* are first formed under the combined surface tension and the pressure in the cell. These bubbles gradually increase in size as current continues to flow and this eventually leads to their separation from the electrodes and their rising in the cell. The growth of the bubbles greatly reduces the surface tension of the surrounding electrolyte, and this still further enlarges the bubbles.

The formation of minute bubbles of gas in the nascent

state is, in fact, the source of the pressure; the expansion of the bubbles compresses the remainder of the gas. Compression can only continue until the total volume of the gases becomes equal to that of the water out of which it has been produced. If, however, a certain amount of water under pressure is supplied by the pipe *g*, the total volume of gas remains constant, or may even fall a little.

It is well known that the bubbles of gas initially formed are exceedingly minute, and the surface tension of the surrounding electrolyte reaches values of several thousand atmospheres, so that the pressures of 150-200 atmospheres used in these electrolytic cells are comparatively insignificant. The investigator was also able to verify the effect of the volume change on the voltage. He found (like Fanjung) that the resistance of the electrolyte fell with increasing pressure due to the change in degree of dissociation. The voltage in the electrolyser is, in fact, found to fall off with increasing compression, although it is also possible to make the voltage



(*a*) The Voltaic series voltage. (*b*) Rise in voltage (ten times the scale). (*e*) Over-voltage. (c) Voltage used at the electrodes, in excess of the Voltaic series voltage (allowing for polarisation effect, but not for c^2R loss). (*d*) Ditto, including c^2R loss. (*c*) Pure ohmic voltage drop. (*e*) Voltage and energy used in cell for 1 cubic metre of gas. (E) Voltage drop in the electrolyte. (E_1) Total voltage and energy used in the high-pressure electrolyser. (*f*) Energy used at atmospheric pressure. (*f*) Gain in energy with high-pressure electrolysis as compared with electrolysis at atmospheric pressure. (*g*) Total energy used with electrolysis at atmospheric pressure, including the energy used in the compressors. (G) Energy used with compressors. (G_1) Total gain in energy with high-compression electrolysis as compared with atmospheric electrolysis with subsequent compression.

Fig. 4.—Effect of Compression on the Various Components of the Energy and Voltage used, all at 1,500 Amperes.

increase by adopting a special construction. Noeggerath determined the importance of the "critical current density." The value of this varies extraordinarily in electrolysis, and the value of the voltage at the "critical current density" is the same as that under infinite compression. For current densities above the critical the voltage approaches infinity, *i.e.*, electrolysis becomes impossible, whilst for current densities below the critical value, the voltage falls and apparently approaches the voltaic series-voltage for oxygen and hydrogen.

As a result of experiments with the high-pressure electrolyser the relation between the compression and the various components of the dissociation voltage has been determined and is shown in fig. 4. A current of 1,500 amperes was employed, *i.e.*, the current necessary for the production of 1 cubic metre of gas per hour at normal temperature and pressure. By comparing G_1 and E_1 it is interesting to note that electrolysis at atmospheric pressure requires some 25 per cent. more power than if carried out under compression. A further economy is effected by the reduced dimensions, the Noeggerath apparatus being very decidedly smaller than one built for atmospheric pressure.

Measurements made by the German State Railways with this apparatus show that from 3 to 3.5 kWh are required per cubic metre. The separating diaphragm, which is the most important part of the apparatus, is found to work for years without trouble. The complete electrolyser itself works entirely satisfactorily, even when the pressure is increased to 300 atmospheres. The purity of the gases is also exceptionally good, the values (without purification by katalisers) being 99.1 per cent. for oxygen and 99.9 per cent for hydrogen.

Fig. 3 shows one of these electrolysers with internal tubular electrodes suitable for 120 cubic metres per hour (1 million cubic metres a year). The floor space occupied is only 2 square metres. The arrangement is such that in spite of the series connection of the chambers the outer casing and the pipes are at the same potential as the surrounding gangways and earth. An additional advantage is the absence of separate compressors with their power consumption and space and staff requirements.

These advances in water electrolysis have led to a great expansion in the economic use of hydrogen and oxygen gases for various industrial purposes. In the chemical industry reduction and oxidisation processes can now be carried out using the gases direct in place of the existing chemical methods. Other chemical possibilities are in connection with the artificial nitrogenous manures and in the hydration of oils and fats.

Another very large field would be for superheating in boiler installations—perhaps combined with a suitable heat-storage system. Since heat transference through actual mixture undoubtedly effects great economies in space, the possibilities of the use of commercially pure oxygen and hydrogen as condensible heating materials would seem to be considerable. Thus, in D.R.P.437,978 a special burner is described for using the two gases. In order to avoid excessive temperature at the burner and leading-in pipes, provision is made for mixing some of the steam with the gases before or during combustion.

By the use of a high-compression electrolyser combined with a superheater and storage system for oxygen and hydrogen, the boiler plant is considerably relieved and can be reduced in size by an amount corresponding to the superheating power (usually some 18 per cent.). The cost of the boiler plant in large stations amounts to some £5 10s. per kW of machinery installed, and this can be reduced about 15 per cent. by fitting the Noeggerath apparatus. Another possible application is in connection with long-distance gas supply. The compressed hydrogen, at a pressure of 200 atmospheres or more, can be cheaply distributed to very great distances in small-diameter pipes lines, and this high-pressure gas can then be used to compress other gases to 30 or 40 atmospheres without the aid of mechanical compressors. Both hydrogen and oxygen are also in large demand for welding purposes, for filling air ships, &c.

One other novel application may be mentioned. A German patent (No. 431,570) was taken out by Hausmeister some years ago for improving the efficiency of internal combustion engines by the addition of small quantities (½ per cent. or so) of an explosive mixture of hydrogen and oxygen to the vaporised petrol mixture. With this addition considerably improved combustion was effected, even when very inferior oils were used. In this way as much as 70 per cent. of the fuel cost can be saved. It is interesting to remember that the burning of a given volume of $2H + O$ mixture produces many times the energy of the same volume of petrol vapour, and further that the pressure can, theoretically, be increased to 1,865 atmospheres. The weight relation between liquid water and the same volume of its component gases of atmospheric pressure is, in fact, 1,865, so that if the water is electrolysed without allowing it to increase in volume the resulting gas has a pressure of 1,865 atmospheres—a number which has been called the "volume energy" by Sir Oliver Lodge. Although these considerations are only theoretical at present, the cheap production of high-pressure oxygen and hydrogen opens up possibilities which may revolutionise the motor car and aeroplane industries eventually.

D

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations, and Failures.

British Capital in Argentina.

On the day of the departure of the British Economic Mission to Argentina and Brazil (August 2nd) *The Times* published a special article upon the above subject from its Buenos Aires correspondent, in which reference was made to the recent decisions of certain Argentine Railway Companies, constructed by means of British capital, to secure British control. The correspondent then dealt with the influx of American capital into Argentina. He said that "two years ago United States capital investments in Latin America were practically confined to loans to the National, Provincial, and Municipal Governments of the Republics. Since then American interests have been very active in buying electrical power plants and in arranging concessions for power service where such enterprises did not already exist." He further stated: "It is believed that a veritable avalanche of American capital is being directed upon Argentina for the purpose of making the whole of Latin America 'safe' as a convenient, accessible, and dependable territorial mechanism of absorption of the increasing surpluses of United States industry. If the purchase of existing enterprises is a means to the end of ensuring a convenient future outlet for the manufactured articles of American factories rather than a means of giving employment to capital, American capital might well be starting on the road to a virtual monopoly of the enterprises standing for foreign capital invested in Argentina."

Realising what British capital has done for the Republic, the Argentine people are not anxious to see a change of ownership of important national undertakings. The view was expressed to the writer that if the railways were sold the British might "pack up and get out." It is pointed out that it would be difficult to re-invest in Latin America the capital raised from such a sale, and it would be a great blow to British prestige. The correspondent says that "every future sale of a British undertaking will be regarded either as an admission of inferior qualifications for the efficient and profitable operation of the enterprise or as a lack of vision of Argentina's future."

London Contractors' Holiday Terms.

Mr. L. C. Penwill, secretary of the London branch of the National Federated Electrical Association, has communicated with all members of the London branch (in the London area) as follows: "I would remind you that at the meeting of the London Disputes Committee, held on May 7th, 1929, it was agreed that the second part of the 'Note' under Clauses 6 and 7 of the London Agreement, reading as follows, be cancelled forthwith: 'For the London area the following five days have been agreed in accordance with this clause, namely, Good Friday, Saturday before Easter, May Day, Tuesday after August bank holiday, and the day after boxing day.' In the circumstances, therefore, time-and-a-half will not be payable for hours worked on the Tuesday after August bank holiday, or, of course, on any other of the five days above mentioned."

Railway and Road Transport Agreements.

It was announced last week that important measures of co-ordination of railway and road transport services were about to be made. The parties to the principal agreement are the L.M.S. and L. & N.E. Railway Companies and the British Electric Traction Co., Ltd., which controls a number of omnibus and tramway undertakings. Further agreements are to be made by the railway companies with other motor service and tramway undertakings.

Men Wanted in Malaya.

A correspondent in the Federated Malay States states that the Chief Secretary in his 1928 report on Selangor said that the large increase in the demand for electric power had necessitated the employment of more qualified men, in accordance with the Electricity Enactment. There was a scarcity of such men as wiremen, chargemen, and first-, second,- and third-grade electrical engineers. The Chief Secretary expressed the hope that the trade schools would remedy that state of affairs.

The same correspondent informs us that the Malaya Collieries Co., Ltd., is developing its electrical installation for various purposes, and has recently placed an order with the Metropolitan-Vickers Co. for two 2,000-kW turbo sets as the first instalment of its a.c. scheme.

Increased Telephone Development Urged.

The Postmaster-General, Mr. H. B. Lees-Smith, received in private on July 31st a deputation representing the Telephone Development Association and the Joint Industrial Council of the Cable-making Industry, which urged a more intensive policy of telephone development as a means of increasing business efficiency, and at the same time providing increased employment on a remunerative basis. The deputation was introduced by Sir Alexander Roger.

New Indian Companies.

Among the new companies recently formed in India in connection with electricity supply are the Associated Electric Co., Wakefield House, Ballard Estate, Fort, Bombay, capital 1,000,000 rupees; and the Kasauli Electric Supply Co., Kasauli, Bengal, capital 500,000 rupees.

The Cuttack Electric Supply Co. has been formed in Cuttack, India, a town of about 50,000 inhabitants. The company's power station will be equipped with oil-engine plant.

Liverpool's Contribution to Research.

Subject to the approval of the Electricity Commissioners, the subscription of £200 per annum from the revenue account of the Liverpool electricity supply undertaking to the British Electrical and Allied Industries Research Association is to be increased to £500 per annum.

Apprentice-Training in the United States.

Electrical Contracting (Chicago) reports that under the supervision of the Federal and State Boards of Vocational Training, the Detroit Electragists (contractor-dealers), Electrical Workers' Union, and Detroit Board of Education have been conducting a trade school for electrical apprentices, the union furnishing the instructors, the electragists the materials, and the school board the metering equipment and school rooms. Ninety-two have been graduated, and all are working at the trade, while thirty-six were dropped for non-attendance or inability to learn the trade. The arrangements of the scheme are as follows:—The term of apprenticeship is four years; an apprentice must be over eighteen years of age before he is allowed to enter; each apprentice must spend one full day of eight hours out of each two weeks; each apprentice is paid 10 per cent. above his hourly rate by his employer, which amounts to one full day every two weeks; any time lost at school by the apprentice must be made up; any apprentice missing three days from school is dropped from the roll unless he has a legitimate excuse; each apprentice must pass an examination before he is classed as a journeyman; there are two electrical instructors who have had practical as well as theoretical experience; the course is divided into the following four divisions: theory, mathematics, practical electricity, and drawing and blue print reading.

Forthcoming Exhibitions.

The following exhibitions are to be held during the latter part of this year; all of them will include electrical machinery, apparatus, and equipment:—

International Bakers' and Confectioners' Exhibition, Agricultural Hall, September 7th to 13th.

Shipping, Engineering and Machinery Exhibition, Olympia, September 12th to 28th.

Wireless Exhibition, Olympia, September 23rd to October 3rd.

Exhibition of Inventions, Central Hall, Westminster, October 2nd to 12th.

International Motor Show, Olympia, October 17th to 26th.

International Commercial Motor and Transport Exhibition, Olympia, November 7th to 16th.

Public Works, Roads and Transport Exhibition, Agricultural Hall, November 18th to 23rd.

Cycle and Motor Cycle Show, Olympia, November 30th to December 7th.

New Corporation Showrooms.

On July 26th the Lady Mayoress of York (Mrs. E. J. Rymer) opened new showrooms which the Electricity Department has constructed in Clifford Street. Alderman Shipley, chairman of the Electricity Committee, in presenting the Lady Mayoress with a decorated reading lamp, said that the Corporation now had 152 all-electric houses which were giving entire satisfaction to the tenants.

An F.B.I. Forecast.

The quarterly "Business Barometer" issued by the Federation of British Industries, covering the third quarter of the year, states that trade and employment have been well maintained during the past quarter, and for the first time for many years the seasonal slowing-up of the early summer months has been moderate. There has, however, been no appreciable change in the general outlook, and the adverse influences noted in the two previous issues have shown no signs of abatement. The development of trade and the maintenance of price stability continue to be threatened by the prospect of dearer money and the limitation of financial facilities. The period of price unsettlement foreshadowed last quarter has materialised, and, if it continues, is likely to result in a falling-off in the volume of new orders during the coming quarter. Industrial unrest in important industries is an additional disturbing influence.

Trade Announcements.

Mr. J. P. MOORES, electrical engineer, Northwich, has removed to larger premises in Castle Street.

Owing to increased business, VENNER TIME SWITCHES, LTD., 45, Horseferry Road, S.W.1, has installed additional telephone facilities. The call number is the same as heretofore, namely Victoria 2552 (private exchange). The company states that it is exhibiting at the Barcelona International Exhibition and has a wide range of its products on Stand No. 80 in the British Section.

The works of Messrs. Chesterton, Jones & Co., Ltd., have been removed from Walsall to David Works, Rushey Lane, Tyseley, Birmingham.

French Electrical Co-operation.

It is stated that a working community has been established between the Société Financière Elêctrique (the financing company of the Thomson-Houston group) and the Union Financière pour L'Industrie Electrique (the financing company of the group of the Union de l'Eléctricité). The arrangement is being carried out by means of an interchange of shares and directors.

Another Polyglot Catalogue.

We have received from MESSRS. MAWDSLEY'S, LTD., Dursley, Glos., a copy of a catalogue which they have recently issued, dealing with their electric arc welding sets. This is not only a handsome publication; the principal feature is that it is printed in five languages—English, French, German, Italian, and Spanish, making it suitable for many markets.

The Rumanian Electrical Market.

In the course of a Department of Overseas Trade report on Rumania (Stationery Office, 1s. 6d. net), Mr. R. S. E. Humphreys, Commercial Secretary at Bucharest, says that the electrical machinery imported into the country comes from Germany. Such firms as the A.E.G. and Siemens-Schuckert have their own selling branches in Rumania, which hold stocks and secure most of the Government and municipal orders for town lighting, motors, and other machinery and materials. Other countries practically do not count in this branch.

In another part of the report, however, reference is made to a new broadcasting station, the construction of which was commenced by a British firm last year. The restrictions on the importation and use of radio apparatus have been removed, and British radio manufacturers have now the opportunity of making their goods known in a market where the demand for radio instruments is likely to increase considerably in the near future. An exhibition of radio apparatus is being held in Bucharest from August to October.

Unemployment.

The Ministry of Labour returns for the week ended July 22nd show a decrease of 14,065 in the number of registered unemployed. On the date mentioned the total was 1,122,000, against 1,136,665 on July 15th and 1,282,934 on July 23rd, 1928.

The Minister of Labour says that as these total figures which are generally quoted do not give a true impression of the state of employment, she intends to issue, in addition, a monthly statement summarising the weekly figures and giving the estimated numbers of insured persons in employment.

The weekly totals are misleading when quoted without qualification, for the reason that they include persons temporarily stopped (292,300 on July 22nd) and persons normally in casual employment (74,300 on July 22nd).

Norway's Foreign Electrical Trade.

The value of electrical machinery and apparatus imported into Norway during 1928 was 18,776,186 kr. (£1,031,660), as compared with 15,806,800 kr. (£868,500) in 1927. During the same period 28,624 kg. of electric motors (against 1,263 kg.) and 46,176 kg. of telephone and telegraph apparatus (against 13,101 kg.) were exported from Norway.

Jugo-Slavian Electrical Imports.

The imports of electric machinery into Jugo-Slavia attained a value during last year of £582,246, as compared with £490,942 in 1927.

Bankruptcy Proceedings.

ELIZABETH ANN WARNES, 10, Crescent Gate, Wilmslow Road, Rusholme, Manchester, electrical and radio engineer.—The receiving order in this matter was made on June 10th on the debtor's own petition, and according to the statement of affairs there are liabilities of £1,158, against assets estimated at £524. From that has to be deducted preferential claims of £60, leaving net assets of £464, or a deficiency of £694. The debtor attributed her failure to competition, bad trade, and losses in connection with an agency. She financed her eldest son in the manufacture of wireless coils, but early in 1927 she paid his creditors 10s. in the £, involving a total loss of £1,000 in this business. In January, 1927, she leased a shop at Crescent Gate for seven years at £150 a year, and opened an electrical and radio engineering business. She contributed £500 as commencing capital, but periodically since then she had realised all her shares and property to provide further capital. The business, according to a rough account prepared to June, 1928, showed a loss of £600. She advanced £200 to a firm of patent electrical plug makers in order to obtain a sole selling agency, but the plugs were never marketed owing to an alleged infringement. The debtor has kept a cash book and purchase and sales ledgers, and states that she became aware of her position in January, 1929. The following are creditors:—

	£		£
Brandes, Ltd.	44	Magnes & Pearn ...	30
Cossor, A. C., Ltd. ...	60	O'Brien, R., & Co. ...	20
Downes & Davies ...	27	Philips Lamps, Ltd. ...	43
Electrical Components, Ltd.	40	Roberts, John	27
Hirst Ibbetson & Taylor Ltd.	83	Reckless, Miss Fanny ...	175
Mullard Wireless Service Co., Ltd.	53	Sharratt Electrical Co., Ltd.	30
Macintosh Cable Co., Ltd.	48	Toubkin, J.	28
		Warnes, W. H.	125
		White, J. C., & Co., Ltd.	72

R. A. READ, electrical engineer, 9, The Pavement, Middle Lane, Crouch End.—The first meeting of creditors was held last week at the London Bankruptcy Court. The debtor stated that he began business in September, 1926, with £50 borrowed capital, dealing in wireless goods and carrying out electrical installations. He owed about £800, against assets of £350. The failure was attributed to high rent and liability in respect of premises formerly held by the debtor, but the immediate cause was the issue of a writ by the landlord of his private residence, combined with pressure from wholesalers, which caused him to close down the business and file his petition. The case was left in the hands of the Official Receiver.

GERALD TALBOT BAINES, 66, High Street, Gorleston, electrical engineer.—The first meeting of creditors was held on July 27th at the Official Receiver's Office, 9, Queen Street Chambers, Norwich. The statement of affairs showed liabilities of £350, against assets of £55, leaving a deficiency of £295. The debtor stated that he commenced trading on his own account in July, 1925, and carried on for one year. For the next two years he did no work, owing to an accident which he sustained to his leg. He recommenced trading again in March, 1928, with £40 capital, which he borrowed. He had only kept a memorandum book containing customers' accounts for work done. The matter remains in the hands of the Official Receiver as trustee of the estate. The following are creditors:—

	£		£
Baxter & Caunter, Ltd.	43	Lillywhite, Ltd.	27
Churchmans, Ltd. ...	40	Bankers	33

Colonel TEMPEST, 4, Manns Court, Bradford, electrician.—The first meeting of creditors of this debtor was held on July 26th at the Official Receiver's Office, 12, Duke Street, Bradford, when the debtor attributed his failure to loss through bad debts, loss of contracts, and decline in trade owing to the depression in the textile industry, his contracts being formerly obtained mainly from manufacturers. He returned a statement of affairs showing ranking liabilities of £1,382, and there was a deficiency of £985.

W. H. LAURENS, 492, Prescot Road, Old Swan, Liverpool, radio engineer.—Last day for receiving proofs for dividend, August 14th. Trustee, Mr. J. Allcorn, Government Buildings, Victoria Street, Liverpool.

C. H. DAVIES, 6, Stamford Arcade, Ashton-under-Lyne, electrical engineer, contractor, &c.—Trustee, Mr. J. D. Turner, Official Receiver, Byrom Street, Manchester, released July 22nd.

Company Liquidations.

SOUTHEND RADIO AND GRAMOPHONE CO., LTD., wireless dealers, etc., Queen's Road, Southend-on-Sea, and Wickford, Essex.—The statutory meeting of creditors was held on August 1st at Caxton Hall, S.W. It was reported that the usual resolution for voluntary liquidation had been passed, but the liquidator had not had time to go fully into the position of the company, and no detailed statement of affairs had been prepared. He estimated the liabilities at about £500, and the assets at £480. The gramophone department of the business had been disposed of to one of the late directors of the company. That director had also taken over one of the shops at Southend, and agreed to discharge the rent outstanding. The stock at that shop had been disposed of on advantageous terms. The lease of the

premises at Wickford belonged to the mother of one of the directors. The business there had been a small one, and consisted chiefly of accumulator charging. At one time the company had a branch business at Rayleigh, but it was sold to one of the directors last April. The sale price was £180. The liquidator stated that the company was registered on October 13th, 1928, with a nominal capital of £1,000, all of which was issued for cash. The trading actually started on January 1st last, when certain businesses which had previously been carried on by Mr. F. A. Mayer were taken over. The representative of Messrs. A. J. Dew & Co. said he thought it was a case which called for investigation. His firm had issued a writ to which an appearance was entered, and it agreed to the matter being adjourned generally owing to liquidation taking place. Mr. N. Cramp, of the Wholesale Traders' Association, said that it appeared that, whilst the shares were issued for cash, money had to be expended in purchasing the assets which were acquired from Mr. Mayer. The latter was apparently the chief shareholder. A resolution was passed in favour of an application being made to the Court for the appointment of Mr. C. Latham, Wireless and Radio Trades Guardian Association, 73, New Oxford Street, W., as liquidator of the company. The following are creditors :—

	£		£
Dew, A. J., & Co., Ltd.	79	Harvey & Sons	20
Dubilier Condenser Co. (1925), Ltd.	55	Itonia Gramophone Co.	22
Long & Carter	37	Kilster-Brandes, Ltd. ...	25
Lamb & Co.	23	Chloride Electrical Storage, Co., Ltd.	28
		Branson, Kent & Co. ...	56

Decorative Lighting, Ltd., 146, High Street, Kensington, and 16, Church Street, Chelsea, electrical engineers and decorative lighting experts.—A meeting of creditors was held on July 31st at the offices of Messrs. Beecroft, Sons and Nicholson, 12, Wood Street, E.C., when Mr. Thos. Taylor, the liquidator, stated that the liabilities amounted to £1,220, and the net assets to £332, leaving a deficiency of £888. The company was incorporated in November, 1927, to take over a business which had been formerly carried on by Messrs. Cunningham & Slater, who were the present directors of the company. The nominal capital was £100, in shares of 1s. each, and 40 shares had been issued for cash. In October, 1928, the company acquired as from September 30th, 1928, the assets and liabilities of the Artistic Shade Co., a partnership concern which was being carried on by the two directors of the company at the same address as the registered offices of the present company. During the first year's trading a profit was made, but subsequently losses were incurred, and owing to the very small issued capital, the company were unable to continue the business, and consequently resolutions were passed for voluntary liquidation. The creditors confirmed the appointment of Mr. Taylor as liquidator. An informal committee of inspection, consisting of the three principal creditors, was also appointed.

Chirk Electricity Supply Co., Ltd.—Winding up voluntarily with a view to the sale of the undertaking to the Electricity Distribution of North Wales and District, Ltd. Liquidator, Mr. W. G. Lloyd, 8, West View, Rhosywaen, Chirk, appointed July 11th.

A.E.G. Electrical Co. of South Africa, Ltd., 6, Old Jewry, E.C.—Supplemental dividend of 2.87d. in the £, payable to ex-enemy creditors on July 26th at the office of the Official Receiver and Liquidator, Carey Street, W.C.2.

Handley & Robinson, Ltd.—Creditors must send particulars of debts or claims, &c., to Mr. G. H. Tulloch, 40 & 41, Dame Street, Dublin, the official liquidator of the company, before October 1st, 1929. See notice appearing in our Advertisement Supplement.

Private Arrangements.

Joseph Leadbetter, trading as "Fleetwood Accumulator Service," rear of "Brooklands," The Esplanade, Fleetwood, wireless dealer.—A meeting of creditors was held on July 30th at Blackpool, when a statement of affairs was submitted showing ranking liabilities of £1,112 and assets of £216, leaving a deficiency of £896. The debtor commenced trading in 1926 with a capital of about £20. A full set of books had not been kept, but the business was apparently successful up to January last, when a fire broke out on the premises. The debtor received £254 from the insurance company, but he estimated that he suffered a loss of at least £200. The business was also dislocated through the fire. It was estimated that, including the fire, there was a loss during the year to May 31st last amounting to £470. The drawings had been small. The creditors accepted an offer of a composition of 10s. in the £. The following are creditors :—

	£		£
Chorlton Metal Co., Ltd.	33	General Electric Co., Ltd.	29
Dyson, F., & Co., Ltd. ...	26	Hart Accumulator Co., Ltd.	21
Electric Lamp Factors, Ltd.	63	Marconiphone Co., Ltd.	23
Ellis & Mort, Ltd. ...	210	Mullard Wireless Service Co., Ltd.	25
Fleetwood U.D.C. ...	29	Royal Accumulator Co.	26

Deed of Assignment.

A. Holmes, J. H. Holmes, E. Holmes and S. Holmes (trading as J. H. Holmes & Co., W. H. Holmes & Sons, and the Castle Brand Co.), Newcastle.—The trustees under this deed of assignment, Messrs. J. Miller and J. Taylor, Gibb Chambers, Westgate Road, Newcastle-upon-Tyne, have notified the creditors of their intention to pay a second dividend of 3s. 4d. in the £. A first dividend of 6s. 8d. in the £ had previously been declared. The trustees state that certain electrical contracts have been completed, or sold, and the only matters now delaying the winding up of the estate are the collection of book debts and the realisation of certain assets in the separate estates. It will be some considerable time before the final dividend can be paid and it will only be a small one.

Recent Contracts.

The English Electric Co., Ltd., has sent us some details of its part of the L.C.C. tramcar contracts mentioned in our "Contracts Closed" section last week. The order covers 50 double-deck all-steel tramcars and 100 motor equipments. The cars will each have seating accommodation for 28 passengers in the lower saloon and 46 passengers in the upper saloon. The equipments will each consist of two 57.5-h.p. motors with controllers, circuit-breakers, resistances, cabling and trolleys. The cars and equipments will be built at the company's Preston works. The total value of the contract is £160,450.

The English Electric Co., Ltd., has received an order from the Nottingham Corporation for twenty double-deck, top-covered 'bus bodies. The bodies will be mounted on chassis of the Associated Equipment Co.'s manufacture, the chassis being of the four-wheel type. Each 'bus will have seating accommodation for 51 passengers.

Birmingham Electric Furnaces, Ltd., has received an order from Messrs. Chas. Clifford & Son, Ltd., Birmingham, for an electric furnace having a usable hearth 7 ft. long by 3 ft. 9 in. wide with a maximum rating of approximately 120 kW for brass annealing. This furnace will be supplied complete with a "Birlec" 3-arm electrically-driven charging machine and loading trolleys.

Messrs. Henry Simon, Ltd., have received an order from the Liverpool Corporation Electricity Department for the mechanical coal discharging plant required in connection with the new power station which is being erected at the Clarence Dock. The plant will have a handling capacity of 440 tons of coal per hour, and will include belt conveyors for transferring coal from receiving bunkers below railway tracks to the storage bunkers in the boiler house. There will be two lines of conveyors under the receiving bunkers, each approximately 400 ft. long, a main conveyor in a steel gantry connecting the receiving bunkers with the storage bunkers, which will be 450 ft. long, and a distributing conveyor 200 ft. in length over the storage bunkers themselves. The contract includes all the necessary structural steel work and the electrical equipment for the coal discharging plant, in addition to the installation of the mechanical conveyors. Messrs. Simon have also secured an order for two 70-ton pneumatic coal-handling plants from the New South Wales Electric Tramways and Light Co., Sydney.

The German A.E.G. and the G.E.C.

The following *Reuter* dispatch was received from Berlin on August 2nd :—"A working agreement has been concluded between the Allgemeine Elektrizitäts Gesellschaft, of Berlin, and the General Electric Company of America. The agreement, which is world-wide in scope, provides for the acquisition by the American Company of a nominal thirty million marks of shares in the Berlin company at 200 per cent. An extraordinary general meeting of the Allgemeine Elektrizitäts Gesellschaft shareholders will be called and asked to sanction the increase of the share capital from 186,250,000 marks to 210,000,000 marks.

Franco-German Co-operation.

According to a report from Luxemburg, the Siemens-Schuckert Company has entered into an agreement with the French Compagnie Générale d'Electricité in regard to co-operation in the French market. On the other hand, a Berlin report announces that the matter solely concerns discussions which are proceeding between the two companies on the basis of reparation contracts, but that otherwise a closer co-operation does not come into question.

New French Companies.

La Société de la Centrale Thermique de l'Adour is the name of a new company which has been formed in Paris (10, Rue Vezeley) with a capital of 12 million fr. to establish a new steam-operated electric power station.

Another new company, organised with a capital of 10 million fr., is the Société Hydroelectrique des Chutes de la Bigorre (9, Rue d'Aguesseau, Paris) to establish a hydro-electric power station on the River Adour.

Great Britain's Radio Exports.

Statistics published by the *Wireless and Gramophone Trader*, giving details of our radio apparatus export trade during April last, show a total value of £88,786, including £18,826 for valves. Holland was the leading market, taking goods valued at £14,655, including valves £4,640. Spain increased its share to a notable degree, the amount being £13,601 (valves £1,317). Australia, the next in order, was a long way behind with £7,914 (valves £1,849). Other leading customers were Italy £4,324 (valves £108); Union of South Africa £4,261 (valves £1,121); Belgium £4,022 (valves £429); and Argentina £3,575 (valves £1,573).

Estonian Foreign Electrical Trade.

According to the *Board of Trade Journal*, during May last electrical machines, apparatus and implements valued at 613,000 kr. (£33,700) were imported into Estonia. Exports of the same class had a value of 34,200 kr. (£1,900).

Catalogues Wanted.

Messrs. PERCY DOVE & Co., 21, West Street, Stratford-on-Avon, ask for manufacturers' and wholesalers' catalogues and particulars of specialities.

Messrs. P. H. JACKSON & Co., of 174, Corporation Street, Birmingham, are asking for catalogues of electrical plant and accessories.

Book Notices.

Miscellaneous Publications of the U.S.A. Bureau of Standards, No. 92. "Code for Protection Against Lightning" (25 cents).

Prices of Materials.

The following prices are only general, and they may vary according to quantities and other circumstances:—

	CHEMICALS, &c.	Price August 6th.	Fortnight's inc or dec.
a	Acid, Oxalic ... ... per lb.	5½d.	...
a	Ammoniac, Sal ... ... per ton	£60	...
a	Ammonia, Muriate (large crystal) ,,	£52	...
a	Bisulphide of Carbon ... ... ,,	...	...
a	Borax ... ... ,,	£25	...
a	Copper Sulphate ... ... ,,	£25 10s.	...
a	Potash, Chlorate ... ... per lb.	3½d. to 4d.	...
a	,, Perchlorate ... ... ,,	5½d.	...
a	Shellac ... ... per cwt.	£18 10s.	...
a	Sulphur, Commercial ... ... ,,	£11	...
a	,, Roll ... ... ,,	£11	...
a	Soda, Chlorate ... ... per lb.	3d.	...
a	,, Crystals ... ... per ton	£5 to £5 5s.	...
a	Sodium Bichromate, casks ... per lb.	3½d.	...
	METALS, &c.		
b	Aluminium, Ingots ... ... per ton	£95 to £100	...
b	,, Wire ... ... per lb.	1/1 to 1/9	...
b	,, Sheet ... ... ,,	1/1 to 2/9	...
p	Babbitts Metal and Anti-friction Metals—		
	Grade I ... ... per ton net	£196	...
	Grade II... ... ... ,, ,,	£187	...
	Grade III ... ... ,, ,,	£75	...
c	Brass (rolled metal 9" to 12" basis) per lb.	10¼d.	...
c	,, Tubes (solid drawn) ... ,,	1/0½ to 1/1	...
c	,, Wire, basis ... ... ,,	11¼d.	...
c	Copper Tubes (solid drawn) ... ,,	1/3	...
c	,, Bars (best selected) ... per ton	£110	...
c	,, Sheet ... ... ,,	£110	...
c	,, Rod ... ... ,,	£110	...
d	,, (Electrolytic) Bars ... ,,	£84 15s.	5s. inc.
d	,, ,, Sheets ... ,,	£143 10s.	...
d	,, ,, Wire Rods ,,	£94 10s.	...
d	,, ,, H.C. Wire per lb.	11½d.	¼d. inc.
f	Ebonite Rod... ... ... ,,	2/3 to 2/6	...
f	,, Sheet ... ... ,,	2/3 to 2/6	...
n	German Silver Wire ... ... ,,	2/2	...
h	Gutta-percha, fine ... ... ,,	nom.	...
h	India-rubber, Para fine ... ... ,,	11d.	½d. dec.
l	Iron, Pig (Cleveland No. 8.) ... per ton	72/6	...
l	,, Wire, galv. No. 8. P.O. qual. ,	£21	...
g	Lead, English pig ... ... ,,	£24 15s.	15s. inc.
g	Mercury ... ... per bot.	£22 2s 6d. to £22 5s.	...
e	Mica (in original cases) small ... per lb.	3d. to 3/-	...
e	,, ,, medium ,,	4/- to 8/-	...
e	,, ,, large ... ,,	10/- to 20/- & up	...
p	Phosphor Bronze, plane castings ,,	1/3½	...
p	,, ,, drawn bars & rods ,,	1/5	...
p	,, ,, rolled strip & sheet ,,	1/3½	...
p	,, ,, wire... ... ... ,,	1/6½	...
o	Platinum ... ... per oz.	£13 17s. 6d.	...
d	Silicium Bronze Wire ... ... per lb.	1/3½	...
r	Steel, Magnet, in bars ... ... ,,	7½d.	...
n	Tin, Block (English) ... ... per ton	£213 10s. to £214	...
n	,, Wire, Nos. 1 to 16 ... ... per lb.	3/8	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Messrs. James Forster & Co. report that the sudden change which came over the lead market last week emanated from the Continent, where a good demand was experienced, particularly from Russia. Orders from that quarter were received in the London market, while lead was being diverted from here to the Continent, thus making prospective supplies here short. The position at home was unchanged with consumption well maintained. The position of supply and demand was very well balanced, and now that demand is showing signs of revival, higher prices are expected in the near future.

New Catalogues and Lists.

THE REVO ELECTRIC CO., LTD., Tividale, Tipton, Staffs.—An illustrated and priced pamphlet dealing with the "Revo" ball-bearing vacuum cleaner.

MESSRS. JAMES MCMILLAN & Co., 17, Surrey Street, Strand, W.C.2.—A pamphlet advertising Swedish iron and steel for electrical purposes.

BLACKSTONE & Co., LTD., Stamford.—An illustrated and priced folder dealing with various engines, pumps, &c., made by the company.

MESSRS. JARROW & Co., LTD., Scotstoun, Glasgow.—An illustrated brochure describing the company's pulverised fuel equipment.

MESSRS. FRY'S (LONDON), LTD., 24-26, Water Lane, E.C.4.—An illustrated and priced catalogue of the company's hack-saw blades for hand and power-operated saws.

Messrs. SIEMENS BROS., & Co., LTD., Woolwich, S.E.18.—Catalogue 160, Section VI, containing drawings, dimensions and particulars of the company's straight joint boxes.

The METROPOLITAN-VICKERS ELECTRICAL Co., LTD., Trafford Park, Manchester.—Publication No. 1452/9-1, describing the company's complete equipment for small power houses. Six standard sizes are listed ranging from 330 to 3,750 kW and typical general arrangements are illustrated. Also an illustrated pamphlet (452/1-1) briefly describing "Metrovick" self-contained steam turbo-generator sets.

The PERFECTA SEAMLESS STEEL TUBE & CONDUIT Co. (1923), LTD., Plume Street, Birmingham.—Catalogue No. 16 (66 pp.) giving illustrated details and prices of the company's conduit and conduit fittings in a comprehensive manner.

The STURTEVANT ENGINEERING Co., LTD., 147, Queen Victoria Street, E.C.4.—Publication No. 1330, a profusely-illustrated brochure containing notes on vacuum-cleaning installations carried out with "Sturtevant" equipment.

CALLENDER'S CABLE & CONSTRUCTION Co., LTD., Hamilton House, Victoria Embankment, E.C.4.—A stiff-covered catalogue of the company's c.t.s. cables. The list is fully priced and is provided with a thumb index. Also a folder advertising "Anchor" black adhesive tape.

PHILIPS LAMPS, LTD., 145, Charing Cross Road, W.C.2.—Leaflet No. 407F, illustrating and briefly describing four examples of "Phililite" ceiling fittings. Priced.

Messrs. A. REYROLLE & Co., LTD., Hebburn-on-Tyne.—A little folder containing a very brief history of the company, a plan of the North-East Coast Exhibition indicating the company's stand, and a map of the Newcastle district showing the position of the Exhibition.

Messrs. PICKERINGS, LTD., Globe Elevator Works, Stockton-on-Tees.—A booklet with illustrations in colour drawing attention to the company's lifts, and showing them in process of construction.

STEEL PEECH & TOZER, LTD., Sheffield.—A pamphlet on forgings showing a number of the company's products.

VICKERS, LTD., Vickers House, Broadway, Westminster, S.W.1.—A brochure giving a brief explanation of the manner in which the various interests of the company have been combined with the interests of other companies dealing in similar products or otherwise re-organised.

Lighting and Power Notes.

Australia.—SYDNEY.—The *Electrical Engineer of Australia and New Zealand* states that the Municipal Council has issued a comprehensive statement setting forth its estimates of capital expenditure and loan requirements for the year 1929. In the electricity department the capital expenditure to date is £13,536,429. Since 1919 the department has been purchasing a certain amount of energy in bulk from the Railways Commissioners, but it is now establishing a large new generating station, and the bulk supply will cease from September next. The construction of this new plant and the reorganisation of main distribution have necessitated considerable capital expenditure. The amount spent by the department during 1928 was £2,473,459, and it is estimated that the amount required for 1929 will be £2,546,926. This will be expended as follows:—Generation, £948,816; distribution, £940,000; sub-stations, £621,610; miscellaneous, £36,500. The expenditure on generation will complete the first section of the Bunnerong power station. That on distribution covers the laying down of h.p. feeders to provide for the supply of electricity from Bunnerong, the replacing of overhead h.p. cables by underground cables, the general extension of mains to provide for growth of load, and the extension of street lighting. Under the allocation for sub-stations, additional stations are to be constructed to distribute power from Bunnerong, and existing a.c. and d.c. sub-stations are to be extended.

Aylesbury.—SPECIAL ORDER.—At a special meeting of the Town Council held recently it was agreed to make application for a Special Order to supply electricity to the parish of Bradenham, near High Wycombe.

Birkenhead.—ASSISTED WIRING SCHEME.—The Electricity Committee has decided to adopt a scheme of assisted wiring for houses, and proposes to install the necessary wiring in blocks of eight houses. The charge for electricity will be 6d. per kWh through prepayment meters. The Corporation is to do all the wiring.

RECOMMENDATION RESCINDED.—The Town Council, at a recent meeting, sanctioned the rescission of the recommendation of

the Electricity Committee that the Council should acquire the undertaking of the Gayton Park Electricity Co., Ltd., for the sum of £500. It was stated that the decision would have to be reconsidered.

Brighton.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking (engineer and manager: Mr. John Christie) for the year ended March 31st last record a total revenue of £259,227, as compared with £240,493 in the preceding year. Working expenses totalled £160,664, as against £148,539, leaving a gross profit of £98,563 (£91,954). After deducting capital and other charges, there remained a net surplus of £18,749, as compared with £31,811 in 1927-28. A sum of £15,500 was contributed to the general rate. The capital expenditure during the year amounted to £167,941, and included £17,476 for buildings, £86,433 for machinery and plant, and £62,997 for mains. The electrical energy sold increased from 27,160,785 to 32,247,835 kWh, and the maximum supply demanded from 17,200 to 18,700 kW. The average price obtained per kWh fell from 1.90d. to 1.72d.

Chelmsford.—PROPOSED CHANGE-OVER.—The Corporation Electricity Committee has decided to ask the Electric Supply Corporation, Ltd., if it is prepared to agree not to charge more than 6d. per kWh for lighting and 1½d. for power if the Council agrees to the cost of the change of frequency being met by a sinking fund, as suggested by the company. The Town Clerk has been instructed to communicate with the Central Electricity Board, inquiring on what grounds the Board has declined to bear the cost of changing the frequency of the system of supply in Chelmsford, and at the same time urging that Chelmsford shall be included in the national scheme under which the Board has power to bear wholly or in part the cost of the change-over.

Chesterfield.—LOAN SANCTIONED.—The Corporation Electricity Committee has received sanction to the borrowing of a further sum of £43,355 for e.h.p. and l.p. feeder cables and for mains extension.

Coventry.—LOAN.—The City Council has applied for sanction to a loan of £4,120 for new mains.

YEAR'S WORKING.—A total revenue of £324,543, as compared with £309,080, is recorded in the accounts of the Corporation Electricity Department for the year ended March 31st last. Working expenses increased from £162,941 to £183,368, leaving a gross profit of £141,175, as against £146,139. After making provision for capital and other charges, there was a net surplus of £15,258, as compared with £51,900 in 1927-28. Capital expenditure during the year amounted to £239,214. The number of consumers at the end of the year was 21,291, an increase of 2,488 over the previous year. The electrical energy sold increased by over 11,000,000 kWh to 81,273,271 kWh, and the average price obtained per kWh fell from 1.056d. to 0.958d.

Gillingham (Kent).—TWO-PART TARIFF.—The Town Council has adopted a two-part tariff on the basis of a fixed charge per annum of 15 per cent. of the net rateable value, plus ¾d. per kWh, as an alternative to the present flat rate for private properties.

HIRE-PURCHASE SCHEME.—The Town Council has agreed to a recommendation of the borough electrical engineer to adopt a hire-purchase scheme for the installation of wiring and fittings. Work is to be carried out by local contractors, the Electric Light Department to have the right to tender.

Guildford.—STREET LIGHTING.—The Corporation Lighting Committee has recommended that as from April 1st, 1930, electricity be used for lighting the streets in the borough now lighted by gas.

India.—HYDRO-ELECTRIC SCHEME.—The three hydro-electric schemes in the United Provinces, *viz.*, the Sumera, the Bhola falls, and the Ramganga schemes, have now been linked into one scheme with a view to secure more efficient operation. This linked transmission system will supply power to all towns with a population of 5,000 and over in the seven north-western districts. Besides ensuring continuity of supply, this scheme will give the further advantage of supplying electricity to the agricultural district for irrigation pumping. Progress on the scheme so far has been satisfactory. The power stations at Palra and Bhola have been completed. The whole of the machinery is under erection at site, and will be completed by September next, and the Bahadrabad power station will be completed by December next, when a total of about 6,000 kW will be available. As regards transmission lines, out of a total of 156 miles of double-circuit 37,000-V and 682 miles of single-circuit lines, the poles for 243 miles have been erected, and the whole system will be ready by January next. It has been decided that the distribution should be handed over to companies. The cost of the whole scheme is estimated at Rs.92 lakhs for works and plant, and Rs.15 lakhs for establishment and overhead charges.

Irish Free State.—DUNGARVAN.—The electricity undertaking has been taken over by the Electricity Supply Board as from August 1st. The Board is to pay the shareholders of the Dungarvan Electric Light and Power Co., Ltd., the sum of £5,800.

Isle of Thanet.—SPECIAL ORDER.—Application has been made to the Electricity Commissioners by Messrs. Pearson & Dorman Long, Ltd., for a Special Order authorising them to supply electricity in the parish of Stonar and in parts of the parishes of Minster and St. Lawrence (Extra) in the rural district of the Isle of Thanet.

Kingston-on-Thames. — LOAN SANCTIONED.—The Town Council has received sanction to the borrowing of £41,678 for the purchase of new plant.

London.—ST. MARYLEBONE.—*Year's Working.*—We have received from Mr. C. H. Smyth, borough electrical engineer, a statement of accounts of the electricity undertaking for the year ended March 31st last. The total income amounted to £545,116, as against £510,118 the previous year. Working expenses increased from £269,854 to £315,630, leaving a gross profit of £229,486, as compared with £240,264. To the gross profit was added income from other sources, making a total of £232,903 available. Capital and other charges absorbed £210,783, and there was a net surplus of £22,120, as compared with £52,310 in 1927-28. The net capital expenditure during the year amounted to £72,012, and included £19,412 for machinery and £45,156 for mains and services. The sales of electricity increased from 78,264,859 to 94,396,858 kWh and the maximum supply demanded from 45,195 to 53,751 kW. The average price obtained per kWh fell from 1.442d. to 1.302d.

STEPNEY.—*Year's Working.*—The report on the working of the borough electricity undertaking (engineer and manager: Mr. W. C. P. Tapper) for the year ended March 31st last shows a total revenue of £355,846, as compared with £324,377 in the previous year. Working expenses amounted to £165,854, as against £159,058, leaving a gross profit of £189,994 (£165,319), to which was added income from other sources, making a total of £196,368 available. After providing for capital and other charges, there was a net surplus of £47,593, as compared with £27,526 in 1927-28. The capital expenditure during the year amounted to £204,189, the principal items of which were £71,332 for buildings, £63,493 for machinery, and £39,127 for mains. The total now spent on the undertaking stands at £2,104,332. The sales of electrical energy rose from 43,971,804 to 49,112,837 kWh. Nearly half of this increase was for lighting purposes, and was due largely to the success of the assisted wiring scheme. The maximum supply demanded increased from 29,750 to 34,750 kW, and the average price obtained per kWh fell from 1.360d. to 1.164d. During the year 2,609 new consumers were connected. Considerable progress was made in the extension of the Limehouse generating station, the principal work being connected with the new buildings and circulating-water pipes.

Lytham-St. Annes.—YEAR'S WORKING.—The annual report on the working of the Corporation Electricity undertaking shows a total revenue of £68,897, and working expenditure of £43,449, leaving a gross profit of £25,448. There was a net profit of £2,484.

Manchester.—YEAR'S WORKING.—We have received from Mr. H. C. Lamb, chief engineer and manager, a copy of the report together with the abstract of accounts on the working of the Corporation electricity undertaking for the year ended March 31st last. The total revenue amounted to £1,685,889, as compared with £1,604,167 in the preceding year. Working expenses, however, increased from £864,417 to £983,104, and there was consequently a decrease in the gross profit from £739,750 to £702,785. From this surplus the following charges had to be met: Interest, £270,717; sinking fund, £269,475; income tax, £81,701. The net profit, therefore, was £80,892 as compared with £110,942 in 1927-28. Expenditure on capital account during the year totalled £524,657, the chief items being £119,863 for buildings, machinery and switchboards at Barton generating station, £67,458 for transformer and distributing stations, and £312,275 for mains, services and meters. The total now expended on the undertaking stands at £10,469,012. The electrical energy sold increased from 353,492,142 to 375,253,335 kWh and the electricity not accounted for amounted to 66,871,033 kWh, or 14.09 per cent. of the total generated (474,552,150 kWh). The maximum supply demanded rose from 154,110 to 156,370 kW, and the average price obtained per kWh fell from 1.07d. to 1.06d. The extension of Barton station, which was in process of erection in the preceding year, was completed, and was formerly inaugurated in November last. The generating plant has been augmented by the installation of a 40,000-kW turbo-alternator and a 1,000-kW house-service set, new h.p. switchgear, two pulverised-fuel boilers, and three new boiler feed-water pumps. In the Electricity Commissioners' returns for the year 1927-28 of the principle operating statistics for Great Britain, the Barton station has again been placed first for thermal efficiency. Six new public supply sub-stations were put into commission during the year, and additions to the transforming and converting plant were made at a number of existing sub-stations. The 33,000 V transmission lines have been extended to two new points, *viz.*, Droylsden and West Didsbury, where plant for stepping down from 33,000 to 6,600 V has been installed. Extensions have been carried out, or obsolete plant replaced, at a number of 6,600 V public supply sub-stations, and additional equipment provided for large consumers. The mains laid amounted to 63 miles, bringing the total to 972 miles. The change-over from d.c. to a.c. was effected in the case of 3,972 consumers. There was a continued demand for hired cookers, and the total in service at the end of the year was 5,333, an increase for the year of 1,019.

Millom.—LOAN.—Application is being made by the Urban District Council for sanction to a loan of £3,000 in connection with the extension of the electricity supply to Haverigg

Northern Ireland.—PORTRUSH.—At a recent meeting of the Urban District Council a representative of the Antrim Electricity Supply Co. asked the Council to defer the consideration of the tenders received for the supplying of additional plant required at the Portrush electricity works. It was stated that the Antrim Electricity Supply Co. was constructing a large generating plant at Larne, and the company expected to be able to supply Larne and Ballymena by November, and Portrush by March next. The Council granted the request and deferred the consideration of the tenders.

Paisley.—YEAR'S WORKING.—The working of the burgh electricity undertaking for the year ended May 15th last shows a credit balance of £4,766. A price reduction taking effect from May 1st last will cost the undertaking about £4,000.

Price Reductions.—The following reductions in the charges for electricity have been made or recommended in the following districts:—

BATH.—Domestic rate: A reduction of ¼d. per kWh. Lighting: From 6d. to 5½d. per kWh for the first 1,500 kWh per quarter.

HASTINGS.—Lighting: From 4½d. to 4d. per kWh; sliding scale: From 4½d. to 3½d. per kWh. Street lighting and shop-window and outside decorative lighting: A reduction of ½d. per kWh. Domestic power: From 1d. to ¾d. per kWh.

WALTHAMSTOW.—Lighting: From 5d. to 4½d. per kWh for the first 250 kWh, and 4d. for all energy in excess of this amount. External shop lighting: From 3d. to 2½d. per kWh. Combined domestic rate for lighting, heating and cooking based on 12½ per cent. of the ratable value: A reduction from 1d. to 9/10d. per kWh for the secondary charge. Heating and cooking: From 1¼d. to 1¼d. per kWh. Power consumers are to be allowed a discount of 5 per cent. for prompt payment.

BANGOR.—Residence contract system: From 1½d. to 1½d. per kWh for from 200 to 800 kWh per quarter, and from 1½d. to 1d. per kWh for energy in excess of 800 kWh per quarter. Lighting flat rate: From 7d. to 6½d. per kWh.

Sittingbourne.—LIGHTING SCHEME.—The Urban District Council has accepted the tender of the Kent Electric Power Co., Ltd., for installing electric lighting in houses, providing seven points, lamps, and pendants, at £4 per house.

South-East Lancashire Electricity Advisory Board.—ANNUAL REPORT.—We have received a copy of the annual report of the proceedings of the Board for the year ended March 31st. During the year bulk-supply contracts between the Lancashire Electric Power Co. and the Corporations of Manchester and Eccles were approved. No extensions of stations were recommended or approved by the Board, but the construction of 33,000-V transmission lines by the Lancashire Electric Power Co., Manchester and Salford Corporations, and Stretford Urban District Council were approved. Special Orders, or proposals to take out Special Orders, were submitted as follows:—Alderley Edge and Wilmslow Electricity Board, a Special Order constituting this Board as an authorised undertaker in respect of the urban districts of Alderley Edge, Wilmslow, and Handforth, and certain parishes in the rural districts of Bucklow and Macclesfield, and authorising the acquisition of the undertaking of Alderley and Wilmslow Electric Supply, Ltd.; Altrincham and District Electricity Board; Lancashire Electric Power Co.; the Electricity Company of Macclesfield, Ltd.; Manchester Corporation; Mid-Cheshire Electricity Supply Co., Ltd.; and Trent Valley and High Peak Electricity Co., Ltd. A number of applications for Fringe Orders were supported by the Board. The consumption of electricity in the area increased from 837,206,978 kWh in 1927 to 891,290,039 in 1928. Based upon the estimated population in 1928, the energy sold per head amounted to 288 kWh, as compared with 273 kWh in 1927. The cost of administration for the year amounted to £2,295, which, when distributed over the energy sold, yields a figure of 0.00062d. per kWh, as compared with 0.00079d. in the previous year. In connection with the future functions of the Board, the Electricity Commissioners suggested that Joint Electricity Authorities and District Advisory Boards should refrain from making representations or recommendations regarding the extension of existing, or the erection of new selected stations, as such stations would be extended or built after full investigation by the Commissioners and the Central Electricity Board. A Committee appointed by the Advisory Board asked for a joint conference with representatives of the Commissioners and the Central Electricity Board to discuss the matter generally.

FRINGE ORDERS.—Applications for Fringe Orders have been made by the Mid-Cheshire Electricity Supply Co., Ltd., and the Cheadle and Gatley Urban District Council, and the Engineering Advisory Committee has recommended the Board to support the applications.

EXTENSION ORDER.—The approval of the Board, in principle, is recommended to the application of the Mid-Cheshire Electricity Supply Co., Ltd., for an Extension Order in respect of the rural district of Bucklow.

NORTH-EAST ENGLAND SCHEME.—This scheme has been considered by the Engineering Advisory Committee, which has recommended the Board to make representations to the Central Electricity Board against the proposed expenditure on standardisation of frequency in the North-East Area, owing to the fact that a considerable proportion of the annual charge in respect thereof will have to be borne by the undertakers in the district, thus impeding the improvement and development of electricity supply.

TRANSMISSION LINES.—The Committee has recommended that the construction of certain transmission lines by Manchester Corporation be approved.

The minutes of the proceedings of the Engineering Advisory Committee have been approved and adopted by the Board.

Stirling.—YEAR'S WORKING.—The accounts of the burgh electricity undertaking (engineer: Mr. W. R. Murray) for the year ended May 15th last record a total revenue of £17,328 and working expenditure of £11,986, leaving a gross profit of £5,341. The figures for the preceding year were: Income, £16,491; working expenses, £9,938; gross profit, £6,553. After providing for capital charges, there was a net surplus of £295, as against £1,665 the preceding year. The sales of electricity increased from 1,340,540 to 1,547,623 kWh, and the maximum supply demanded from 890 to 970 kW.

Torquay.—SPECIAL LIGHTING TARIFF.—The Corporation Electricity Committee has decided that a special tariff upon the following basis be issued to meet the requirements of consumers desiring a supply of electrical energy for external flood or strip lighting purposes: A standing charge, based upon 25 per cent. of the wattage installed, at the rate of 3s. 4½d. per quarter per 40-W lamp installed for the two summer quarters, a standing charge, based upon 50 per cent. of the wattage installed, at the rate of 3s. 4½d. per quarter per 40-W lamp installed for the two winter quarters, and a "unit" charge of ¾d. in respect of all energy used for flood lighting or strip lighting purposes.

FLOODLIGHTING.—The Publicity Committee has decided to invite two or three expert firms to submit schemes of suitable coloured floodlighting of slopes and gardens for consideration, with an approximate estimate of the cost.

West Ham.—YEAR'S WORKING.—The accounts of the borough electricity undertaking (engineer and manager: Mr. F. W. Purse) for the year ended March 31st last show a total revenue of £370,459, as compared with £379,517 for the preceding year. The total working expenses, including rates and central administrative charges, amounted to £215,726, as against £205,072, the increase being principally accounted for by increased repairs and revised assessment for local rating. The gross profit, £154,733, showed a decrease of £19,712 on the previous year's figure (£174,445). To the gross profit was added income from other sources, making a total of £163,121 available, and after deducting capital charges and special works charged to revenue, there was a net surplus of £18,161, as compared with £50,430 in 1927-28. A contribution of £13,491 was made to the relief of rates. The capital expenditure during the year amounted to £153,288, the chief items being £80,099 for mains and £22,529 for rental wiring installations. The electrical energy sold increased from 82,810,561 to 90,786,354 kWh, of which private power supplies accounted for 45,707,092 kWh, and the maximum supply demanded rose from 29.215 to 33,210 kW. The average price obtained per kWh fell from 1.08d. to 0.96d.

West Lancashire.—LOAN SANCTIONED.—The Rural District Council has received sanction to a loan of £11,508 in connection with the Aughton electricity scheme.

West Midlands Joint Electricity Authority.—The report and accounts of the authority for the year ended March 31st last show a total revenue of £392,929. Working expenses totalled £225,177, leaving a balance of £167,752, which was absorbed by loan charges, contributions to various funds, &c. The capital expenditure during the year amounted to £221,069, the chief item being £157,392 for plant and machinery. The total capital expenditure by the Authority at the end of the year was £1,761,063. The total capacity of the plant installed was 105,000 kW—at Ocker Hill (43,500 kW), Wolverhampton (30,000 kW), Walsall (22,500 kW), and West Bromwich (9,000 kW). The maximum supply demanded reached 73,320 kW. Electricity generated totalled 213,279,120 kWh, of which 195,218,010 kWh were sold. The purchase of 187 acres of land was completed during the year for the erection of the Ironbridge power station. This station, which was originally designed for an ultimate capacity of 160,000 kW, will, under the Central England Electricity Scheme, 1928, have an ultimate capacity of 200,000 kW, and the first section will contain 50,000 kW of plant. The estimated cost of the construction and equipment of the first section and the building and civil engineering work for the second section is £960,570, towards which sanction has been received to the borrowing of £700,000 on account. It is anticipated that the station will be in operation towards the end of 1930 or early in 1931. Under the Central England Electricity Scheme three of the Authority's existing stations, *viz.*, Ocker Hill, Birchills, and Wolverhampton, and the new station, now under construction, have been designated as selected stations. Main transmission lines are to be constructed by the Board for the interconnection of the Authority's stations and for connecting them with the systems of other authorised undertakers. The interconnection of the Ocker Hill, Walsall, Wolverhampton, and West Bromwich generating stations has been completed, and the stations are being operated under unified control. There is now sufficient plant in the Wolverhampton, Walsall and Ocker Hill stations to meet the requirements of the whole of the Authority's system, and it is proposed to close down West Bromwich, which is the least efficient, in the near future.

The construction of the transformer sub-stations at Ocker Hill, Walsall, West Bromwich and Wolverhampton has been completed, together with new switchgear for the generators. The extensions at both Walsall and Ocker Hill were completed towards the end of 1928. The extensions at Walsall include three 75,000-lb. boilers and two turbo-generators, each having a maximum continuous rating of 6,250 kW. At the Ocker Hill station, the extension includes three 75,000-lb. boilers, one turbo-generator with a maximum continuous rating of 12,500 kW, and three film cooling towers. The Authority has approved proposals for the extension of the areas of supply of the Midland Electric Corporation for Power Distribution, Ltd., and the Cannock Urban District Council. The chief engineer and manager to the Authority is Mr. E. F. Hetherington, who succeeded Mr. S. T. Allen on his appointment as Central England Engineer under the Central Electricity Board.

Wick.—ELECTRICITY SCHEME EXTENSIONS.—The Town Council has agreed to borrow £11,000 for the extension of the recently inaugurated electricity scheme. The money is required to provide additional power plant and mains, owing to the demand for electricity being much greater than had been anticipated when the power station was built. It is reported that the Electricity Commissioners have decided to inspect the station with a view to the possibility of a scheme being carried out which will make Wick the central power station for the north of Scotland.

Tramway and Railway Notes.

Brazil.—RAILWAY ELECTRIFICATION.—The State Government of Parana has submitted to the Chamber of Deputies a scheme for the total, or partial, electrification of the Estrada-do-Ferro Parana, one of two railway systems in the State, and of the branch between Curityba and Paranagua, a distance of 66 miles. The estimated cost is 20,000 contos (£500,000). The electrification of the Barra Mansa-Augusto Pestana branch of the Oeste-de-Minas Railway, which has been carried out by Metropolitan-Vickers Electrical Co., Ltd., has been completed and opened to traffic.—*Reuter's Trade Service* (Curityba).

Continental.—FRANCE.—The great increase in the number of motor-'buses running in the Nice district has so reduced the traffic on the tramways that many of them are now being run at a loss. As a result, an agreement has recently been arrived at between the General Council of the Alpes Maritimes Department and the Compagnie des Tramways de Nice et du Littoral, to discontinue running trams over eight routes and to cancel the construction of two lines, a concession for which was granted some time ago. The tramway company is to receive an indemnity of 2½ million francs (about £20,000), and is to be authorised to run motor-'buses in place of trams.

SWITZERLAND.—The Swiss Federal Railway Authorities are considering the best way of providing for the increasing demand for power for the electrified railways—whether to draw supplies from privately-owned power plants or to establish new State hydro-electric and steam generating stations. Although a final decision will not be made until the autumn, it is reported that the authorities are in favour of the latter plan and that two new stations may be erected, one at Etzel and one at Rupperswil.

RUSSIA.—Plans are in preparation for the electrification of the railway between Moscow, Koursk, Kharkov, and the Donetz. The power will be supplied by the Moges station of the Union of Moscow State Power Plants, the Kharkov station, and the Donetz district stations. The line is to be operated by d.c. at 3,000 V.

Crompton.—LOAN.—The Urban District Council, at a special meeting held recently, decided to make application to the Board of Trade for sanction to loans in connection with the Royton and Crompton electric tramway scheme. The total cost of the scheme is estimated at £55,330.

London.—NEW ROTARY CONVERTORS.—The L.C.C. Highways Committee has recommended the expenditure of £51,000 on the provision of three 1,000-kW rotary convertors in the sub-stations at Limehouse, Tooting, and New Cross, e.h.p. switchgear at New Cross, and additional plant at the central repair depôt.

Liverpool.—EXTENSION OF TIME.—The Ministry of Transport has extended the period for the completion of various sections of the tramways authorised by the Liverpool Corporation Tramways Order, 1925, from July 31st, 1929, to July 31st, 1930. An extension of time has also been granted for the completion of a section of the tramways authorised by the Liverpool Corporation Light Railways Order, 1923, from October 31st, 1929, to October 31st, 1930.

Lytham St. Annes.—YEAR'S WORKING.—The annual returns of the Corporation tramway undertaking show that the receipts on the trams amounted to £35,063. A sum of £14,202 was received from Blackpool for through running, smaller items bringing the total income to £49,734. Working expenditure totalled £41,720, leaving a gross profit of £8,013. After deducting capital expenses there was a net deficiency of £3,344, as against £3,052 for the previous year.

Southend-on-Sea.—TRAMWAY ABANDONMENT.—The Town Council is to apply to the Ministry of Transport for an Order for the abandonment of the light railway between Victoria Circus and Prittlewell. Railless cars are to be substituted.

York.—DOUBLING OF TRACK.—The Tramways Committee has recommended that the tramway track from Barrack Hill to Heslington Lane be doubled, at an estimated cost of £10,000.

Telegraph and Telephone Notes.

American Republics.—STATISTICS.—A recent publication of the American Telephone and Telegraph Co. contains interesting statistics of the state of development (on January 1st, 1928) of the communication services of the American Republics, including British, French, and Dutch Guiana, and British Honduras, but not Canada. The total area dealt with is 11,254,600 sq. miles (U.S.A. 3,027,000), with a population of 224,393,000 (U.S.A. 117,300,000).

TELEPHONY.—The number of telephones in use was 18,522,767 in the U.S.A. and 623,531 elsewhere, of which 19,473 belonged to State systems; per 100 of the population the figures were 15.79 (U.S.A.) and 0.58, the mileage of wire being 63,836,182 (U.S.A.) and 1,825,170. The largest individual city was New York with 1,599,915 telephones (26.1 per 100 population), followed by Buenos Aires with 129,503 (6.4), while the smallest city was Cayenne, French Guiana, with 126 (1.0). The money invested in the services totalled $3,548,875,000 in the U.S.A. ($192 per telephone and $30.25 *per capita*) and $153,929,000 elsewhere ($247 per telephone and $1.44 *per capita*). The gross earnings for the year 1927 amounted to $1,023,574,000 in the U.S.A. ($56.44 per telephone and $8.78 *per capita*), and $34,300,000 elsewhere ($59.27 per telephone and $0.32 *per capita*).

TELEGRAPHY.—In the U.S.A. the mileage of telegraph wire totalled 2,152,230 miles and the number of offices was 27,550, while the number of messages sent reached 214,403,000 (in 1927). Elsewhere the figures were 535,109 miles, 15,983 offices, and 53,226,100 messages. The gross earnings reached $152,000,000 ($1.30 *per capita*) in the U.S.A. and $30,145,000 ($0.28 *per capita*) elsewhere.

Beam Radio-Telegraphy. — FINANCE. — The Postmaster-General recently announced in the House of Commons that up to March 31st, 1929, the beam radio-telegraph services of the Post Office had earned gross receipts of £813,100 at a cost of £538,850.

Marine Telephony.—SHIP-SHORE TESTS.—Tests, which hold out the promise of regular two-way telephone conversations between passengers on ocean liners and subscribers on land, were carried out at Paris recently. Using an ordinary city telephone, an engineer in the International Telephone and Telegraph Corporation's laboratory in Paris spoke to a friend in the liner *Berengaria* when she was some two thousand miles distant on her voyage from New York to Cherbourg. The Cunard Co. hopes that it will soon be possible for a passenger to call up his home, or a business man his office, with as much ease as if he were on land.—*Reuter's* (Paris).

Radio Notes.

Atmospherics.—NEW USE FOR FULTOGRAPH.—An enormous amount of research into the origin and nature of atmospherics has been done in recent years by the radio research station at Slough, and the station is now to make use of an entirely novel method of recording them. The Royal Meteorological Society has arranged with the B.B.C. for special transmissions after the normal picture programmes and they will be picked up by Fultograph receivers installed for the purpose at recording stations in various parts of Europe. The transmissions will not take the form of pictures; instead there will be sent out a series of straight lines, both horizontal and vertical, forming a grid or network. When an atmospheric occurs deformation of the straight lines will take place to an extent depending upon the intensity of the interference. It is hoped that by this means it may be possible to make records which will afford valuable data for research into the intensity, duration, and origin of individual atmospherics. Since the drums of all receiving apparatus, wherever situated, will be synchronised, it will be possible, by comparing the results obtained in different places, to determine the range at which an individual atmospheric can cause interference and the intensity of such interference in different localities.

Austria.—NEW STATION.—The prolonged opposition to the erection of a station at Salzburg would appear to have been overcome, for *World-Radio* announces that the Town Council

has agreed to the erection of a 130-ft. mast on the Mönchsberg in order to enable Ravag to carry out tests, without which it considers that the erection of permanent plant would be rash, because the town is surrounded by mountains.

Canada.—PROGRESS.—The rapid expansion of the radio industry in Canada is indicated by a report of the Dominion Bureau of Statistics for the year 1928. Production of complete radio sets, parts, and batteries reached a total value of $12,768,024, or 45 per cent. above the total of $8,789,171 reported for 1927. The output of radio sets, or parts, was reported by 45 different firms, but that figure does not include the number of smaller-custom workers, not classed as manufacturers, who assemble or build to order. Complete sets were made by 14 plants, and the output numbered 81,032 sets, valued at $7,486,127, as compared with a corresponding total of 47,500 sets valued at $3,748,622. Sorage batteries and dry cells manufactured for radio purposes were produced in 16 establishments, and their value toalled $2,456,065, as against $2,572,993 in 1927. Radio licences were issued during the last fiscal year to the number of 296,756, as compared with 268,055 in the preceding year.

Regional Station.—TESTS.—The British Broadcasting Corporation's southern regional station at Brookmans Park recently commenced testing on a closed circuit, which means that reception is not possible beyond a distance of a few yards. The date of radiated tests has not yet been fixed.

Licences.—STEADY INCREASE.—It is interesting to observe that the increases in the number of receiving licences issued monthly during 1929 exceeded all the corresponding figures of 1928. The total in force at the end of June was 2,791,717, being an increase of 16,009 over the May figure, while in June, 1928, the corresponding increase was 12,000.

World Radio.—NINE YEAR'S PROGRESS.—One billion persons are within the range of radio broadcasting stations already established throughout the world, based on information given in a talk by Dr. Julius Klein, Assistant-Secretary of Commerce, U.S.A., who said that on the basis of five listeners to every set there was a potential market for 200,000,000 sets, and that a recent survey by the Commerce Department disclosed that about 20,000,000 were in use, of which nearly two-thirds came from the United States. Even that figure of market potentialities was conservative, he added, for new stations were constantly being erected in all parts of the world. Less than nine years ago, on November 2nd, 1920, there was only one station in the world "on the air." Now there were more than 600 licensed stations in the United States and more than 500 in other countries. On the evening of November 6th, 1928, some 10,000,000 radio sets were used in the United States by 50,000,000 people who heard the news of President Hoover's election, besides thousands of listeners in Europe, even in Africa and half way around the world in Australia, who heard the same bulletins at the same time by means of short-wave broadcasts.—*Reuter's* (Washington).

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Australia.—MELBOURNE.—September 30th. State Electricity Commission. Three 3,000-kVA transformers and spares. (B.X. 5523.)*

October 1st. Posts and Telegraphs Department. Switchboard cords. B.X. 5515.)*

September 17th. Petrol electric sets. (B.X. 5537.)*

Belgium.—BRUSSELS.—August 26th. Post and Telegraph Authorities. Supply and laying of new telephone cables between Ghent and Antwerp, Liege and Combain-au-Pont, Verviers and Francorchamps, and Charleroi and Liege. Particulars (Cahier des Charges Special) for 6¼ fr.

August 21st. Supply of 250 tons of annealed bronze wire in six lots and one lot of 6 tons of annealed copper wire. Particulars (Cahier des Charges Special No. 3,424) for 2¼ fr.

Bury.—August 31st. Installation of electric refrigerator at Florence Nightingale Hospital and the Aitken Sanatorium, Holcombe. Tenders to Mr. F. Wild, clerk to the Bury and District Joint Hospital Board, 2, Cross Street, Bury.

Canada.—Canadian National Railways. Power-driven shovels, with caterpillar traction. (A.X. 8230.)*

Egypt.—CAIRO.—September 23rd. Ministry of Interior. Electric lighting installation and distribution system for the town of Kafr-el-Cheikh (Gharbieh Province). (B.X. 5502.)*

October 1st. Tanzim Department. Ministry of Public Works. Electric lamp standards. (A.X. 8251.)*

Farnworth.—August 16th. Electricity Department. Supply of l.p. cables. (August 2nd.)

Gloucester.—August 26th. Committee of Visitors. Electric wiring installation at the Wotton and Coney Hill Mental Hospital. (July 12th.)

India.—MADRAS.—August 13th. Madras and Southern Mahratta Railway Co., Ltd. 70 a.c. motors and starters for Perambur works remodelling, with spares. (July 26th.)

SIMLA.—August 28th. Indian Stores Department. One 30-kW 2-wire d.c. generating set. (B.X. 5522.)*

London. — CENTRAL ELECTRICITY BOARD.—August 31st. Supply, delivery, and erection of 132,000-V outdoor switchgear for the Mid-East England Electricity Scheme, 1929. (July 19th.)

September 11th. Supply, delivery, and erection of 132-kV overhead transmission lines (approach to Clarence Dock, Liverpool). (August 2nd.)

August 24th. Supply, delivery, and erection of metering equipment for certain stations in the area of the South-East England Electricity Scheme, 1927. (August 2nd.)

LONDON COUNTY COUNCIL.—August 12th. Supply and installation of nine 1,000-kW rotary convertors with static transformers. (July 19th.)

September 9th. Supply and erection of e.h.p. switchgear, &c., for tramway sub-stations. (See this issue.)

COMMISSIONERS OF WORKS. — August 13th. Ironclad unit-type switchgear at the National Physical Laboratory, Teddington. (July 26th.)

HACKNEY.—October 9th. Electricity Department. Three 125,000 normal 150,000 maximum lb.-per-hr. water-tube boilers, chain-grate stokers, &c. One 30,000-kW turbo-alternator, with exciter, &c. Fourteen 6,600-V, 3-phase, metal-clad oil circuit-breaker equipments. (July 26th.)

POPLAR.—August 28th. Board of Guardians. E.h.p. switchgear, 75-kW mercury arc rectifier, and l.p. d.c. switchboard at the institution. (August 2nd.)

Lymm (Cheshire).—August 16th. Waterworks Department. Supply and erection of a vertical electrically-driven centrifugal pump. Particulars (deposit £1) from N. Holt, clerk to the U.D.C., Council offices.

Manchester.—August 30th. Electricity Committee. One 130,000-lb. water-tube boiler, superheater, &c. (August 2nd.)

New Zealand.—WELLINGTON.—Post and Telegraph Department. September 10th. Two-conductor cords. (B.X. 5462.)*

October 16th. Supply and delivery of automatic wall and table telephones. (B.X. 5509.)*

Corporation. September 30th. Electric motors, starters and switchgear for the Milk Department. (B.X. 5508.)*

AUCKLAND.—September 16th. Electric Power Board. Supply and delivery of two 500-kW machines and switchgear for Remuera sub-station; two 1,000-kW machines and switchgear for Point Chevalier sub-station; 22,000-volt switchgear; 6,600-V switchgear; and supervisory control apparatus. (B.X. 5506.)*

INVERCARGILL.—September 23rd. Corporation. Supply and delivery of an 11,000-V, 3-phase, 50-cycle switchboard. (B.X. 5507.)*

Oldham.—August 13th. Corporation. Electric lighting installation for 300 houses. Borough engineer, Town Hall.

South Africa.—PRETORIA.—Posts and Telegraphs Department. August 22nd. Telephone apparatus, including extension magneto bells, bell sets, terminal blocks, condensers, magneto generators, carbon protectors, magneto switch extensions, private branch exchange, central battery switchboards, tumbler switches, and wall and table telephones. (B.X. 5415.)*

Town Council. September 2nd. Supply of columns, fittings, lanterns, &c., required for street lighting, and one master clock for frequency regulation at the power station. (A.X. 8,332.)

BULAWAYO.—September 13th. Municipal Council. H.p. overhead transmission lines with accessories and stepdown transformers, pumps and motors with starters, pipework and float control gear. (A.X. 8181.)*

DURBAN.—September 27th. Corporation. Supply and delivery of three-phase ironclad compound-filled switch panels. (B.X. 5505.)*

JOHANNESBURG.—August 22nd. Railways and harbours. Supply of telegraph material. (A.X. 8335.)*

August 29th. Supply and delivery of 3,000 lamp fittings. (B.X. 5,534.)
August 22nd. City Council. Automatic traffic signals. (B.X. 5547.)*
Cape Town.—September 4th. Town Council. Overhead line material. (A.X. 8334.)*

Uruguay.—Montevideo.—August 17th. Posts, Telegraph and Telephones Administration. Telegraph wire. (A.X. 8229.)*

Uttoxeter.—August 12th. Urban District Council. Overhead 11,000-V transmission line. E.h.p. and l.p. cables and roadwork and public lighting. Sub-station equipment. (July 12th.)

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Barking Town.—Electricity Committee. Accepted:—
Switchboards at Upney sub-station (£609)—New Switchgear Construction Co., Ltd.
Cables, Upney sub-station (£2777).—Hackbridge Cable Co., Ltd.
Switchgear, Axe Street sub-station (£823).—A. Reyrolle and Co., Ltd.

Hull.—Housing Committee. Accepted:—
Electric wiring for cookers and wash boilers.—North Hull estate, 12 houses (£40).—H. M. Nowell, Ltd. Willerby estate, 12 houses (£56).—Holliday & Barker.
Library Committee. Accepted:—
Electric lift at Central Library (£241).—Keighley Electrical Engineering Co., Ltd.
Telephones Committee. Recommended:—
Bronze cable (£81).—W. F. Dennis & Co.
Lead-in cable (£329).—T. Bolton & Sons, Ltd.
Electricity Committee. Accepted:—
Five sets of soot hoppers (£1,263).—Clarke, Chapman and Co., Ltd.

Leeds.—Electricity Committee. Accepted:—
Cables.—W. T. Henley's Telegraph Works Co., Ltd. (£3,900); Enfield Cable Works, Ltd. (£4,182); Macintosh Cable Co., Ltd. (£4,337); Hackbridge Cable Co., Ltd. (£163).
Sub-station switchgear.—A. Reyrolle & Co., Ltd. (£1,060).

Liverpool.—City Council. Accepted:—
Clarence Dock power station.—Coal-handling plant (17,000). Henry Simon, Ltd.
Four boiler units complete with auxiliaries (£246,550).—Babcock & Wilcox, Ltd.
Electric Power and Lighting Committee.—Accepted:—
H.p. switchgear for static sub-stations, during the twelve months ending June 30th, 1930.—Ferguson, Pailin, Ltd. (£528).
L.p. switchgear during the twelve months ending June 30th, 1930.—Metropolitan-Vickers Electrical Co., Ltd. (£731).
Boiler feed pump, complete with motor, bed plate and control gear at the Lister Drive power station.—Pulsometer Engineering Co., Ltd. (£581).

Sheffield.—Electricity Supply Committee. Accepted:—
24 e.h.p. switches (£3,950).—A. Reyrolle & Co., Ltd.

Warrington.—Housing Committee.— Accepted:—
Wiring of houses being erected by Lloyd & Cross (£5 4s. 6d. per house).—Grantham Electric Co., Ltd.
Wiring of houses being erected by M. J. Gleeson, Ltd £4 11s. per A2 type house and £5 10s. per A3 type house).—H. Lilley.
Electricity Committee. Accepted:—
Re-blading two rotor wheels and two stators.—J. Howden and Co., Ltd.

Wellfield.—Durham County Education Committee. Accepted:—
Electrical installation at secondary school (£751).—F. Reid, Ferens & Co.

The "Electrical Review" Service Department.

Inquiries must be accompanied by a stamped addressed envelope. We should be glad to learn the following:—

Makers or suppliers of Firestone glass.

Notes.

The Women's Engineering Society.

The Women's Engineering Society held its seventh annual conference from July 26th to 28th at Bedford College, Regent's Park, N.W.1. On the evening of the 26th, Lady Moir, O.B.E., delivered her presidential address, which included an account of the hardships and dangers she had shared with her husband, the well-known civil engineer and inventor of the medical air-lock, which has so reduced the mortality from caisson disease. Lady Moir's object was presumably to dispel any illusions as to the nature of an engineer's life, but probably her words were more likely to arouse youth of both sexes to the romance of living dangerously. On the other hand, Lady Moir pointed out, shorter working hours and the "sandwich system" of training have made the life of the apprentice less arduous than it was.

Saturday morning was spent in a visit to King George V Dock and a view of some of the members thereat is given below. In the afternoon a lecture by Miss D. D. Buchanan, A.M.Inst.C.E., on "Some Modern Bridges" included much useful and new information on developments in different parts of the world. A dinner was given on Saturday evening at the Lyceum Club to women in other professions. The guests were

The W.E.S. at King George V Dock. Miss V. Holmes, B.Sc.(Eng.), A.M.I.Mech.E., M.Inst.Met. (vice-president), in the foreground.

received by Lady Moir, who presided and, after the loyal toast, proposed the health of women in other professions. In this she was seconded by Brig.-Gen. Mowat (Institution of Mechanical Engineers). Replies were made with a verve and wit that made them memorable by Prof. Winifred Cullis (medicine and science), Mrs. Normanton (law), and Miss Edna Mozeley (architecture). The health of Lady Moir was proposed by Mrs. L. A. Willson, M.B.E. (past president). Lady Moir, in reply, said that all would agree the Saturday evening had been very well spent, a view that met with enthusiastic acceptance. On Sunday representatives of the National Federation of Business and Professional Women's Clubs of America were entertained at tea at Bedford College—the final function of the conference.

In the tenth annual report, the general secretary (Miss C. Haslett) referred to the society as guardian and advisor to young women entering the profession. Many members had achieved distinctions during the year, including Miss Partridge, B.Sc., who had become an A.M.I.E.E. Overseas members continued to take a great interest in the Society and articles and news from them had been published in the *Woman Engineer*, the organ of the Society.

Explosions in Subways.

The Times reports that Dr. F. J. Waldo, the City Coroner, has written to the Home Secretary expressing the opinion that the association of coal-gas and electric cables of any kind in subways should be carefully considered by all local authorities. His representation was based on the recent Embankment subway fire, into which he held an inquiry. Dr. Waldo's report urged that a Government inquiry should be held into the whole London subway question. He thought attention could be usefully given to gas mains and electric cables of all kinds, as well as to methods of inspection, ventilation, and other safeguards against explosions.

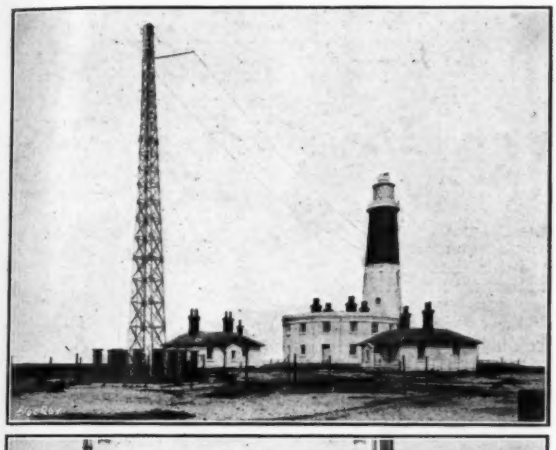
Electric Lighting for Steam Locomotives.

In conjunction with the German steam locomotive building firm, Messrs. J. A. Maffer, of Munich, the Pöge Electricitäts Gesellschaft, of Chemnitz, has devised a compact steam turbo-generator set specially designed to provide electricity for the various lamps used on steam locomotives in place of the oil lamps hitherto employed. The sets, which are made in 0.3- and 0.5-kW sizes, are very compact and comprise in each

case a turbine with a two-crown bucket wheel directly coupled to a 25-W d.c. generator. The set is usually mounted on top of the engine behind the smoke funnel. It is designed to work with steam at pressures between 6 and 16 atmospheres and, running at 4,000 r.p.m., requires only about 112 lb. of steam per hour. The generator runs on ball bearings, and to prevent overheating an air fan is mounted on the shaft between the turbine and dynamo. As installed on one of the engines running on the German State railways, the set supplies electricity for three head lamps, three lamps in the driver's cab, and three lamps at the rear.

The Dungeness Radio Beacon.

Marconi's Wireless Telegraph Co., Ltd., has recently completed a radio beacon at the Dungeness lighthouse for the Corporation of Trinity House. Designed primarily for providing



Exterior and Interior Views of Radio Beacon.

ships in congested areas with a reliable wireless signal for direction-finding purposes, the W.B.2 type transmitter is provided with an automatic code sender which enables interrupted-continuous-wave signals to be transmitted either at definite intervals or continuously during foggy weather. The upper of the accompanying illustrations shows the aerial and mast, while in the lower interior view of the light tower the electricity generating plant can be seen on the left, the automatic code sender and controlling clocks in the centre, and the valve transmitter on the right-hand side.

A New Clock.

Clerkenwell is still true to its traditions, being still the birthplace and nursery of horological attainments. We are reminded of this fact by the new electric double-faced illuminated bracket clock which has just been erected on "Synchronome House," in Clerkenwell Road, Mr. Hope-Jones's home of electric clock inventions. This handsome bracket clock has many original features: it is provided with "sweep-centre" seconds hands, no mean achievement on dials of 3 ft. diameter; the last six seconds of each minute are emphasised by luminous opal disks, and the wireless six-dot seconds are sounded once every hour by apparatus concealed within the case of the clock.

Occupational Diseases.

At the 97th annual meeting of the British Medical Association, which was recently held in Manchester, the Occupational Diseases Section devoted particular attention to a discussion on occupational dusts, which cause such diseases as silicosis among stonemasons and lead poisoning among lead workers. The manufacture of electric storage batteries is one of the most prolific sources of lead poisoning, for which reason members of the Occupational Disease Section paid a visit to the Exide battery works at Clifton Junction, near Manchester, with a view to seeing the up-to-date methods at present employed to control lead poisoning and the steps taken to reduce the amount of lead in the atmosphere. There are elaborate systems of local exhaust ventilation by which suction fans draw away the lead dust from certain processes before it can be inhaled by the workmen. All the safeguards are under the supervision of a resident doctor, who was appointed by the Chloride Electrical Storage Co., Ltd., at the end of 1927 to devote the whole of his time to the study of lead-poisoning disease. An important feature of disease prevention at the works is that of blood examination, conducted periodically. By this means any increase in the amount of lead absorption is detected long before there is any symptom of trouble. In this way any defective process on which a man is employed is at once discovered, overhauled, and preventative methods adopted before poisoning has had the opportunity to develop.

Russia Buys American Turbo-Generators.

The *Pravda* announces that orders have been placed in the United States for electrical material for the "Dnieprostroi." The arrangements have been made by a special commission presided over by Mr. Vinter, an engineer who went specially to America to make inquiries after having visited various European countries. A contract has been concluded whereby the construction of the generators is to be undertaken by the General Electric Co. of America. The manufacture of the turbines will be in the hands of the Morris group. The American industry will supply four 80,000-kilowatt turbo-generators under a fixed time limit. As the "Dnieprostroi" will need ten groups of 80,000 kilowatts each, an order for six more has yet to be given, and it will probably be placed in the Soviet works, which have arranged for American technical assistance.

Welded Buildings in America.

The number of buildings erected by the use of electric-arc welding has increased by 50 per cent. during one year, according to Mr. Frank P. McKibben. In a list published under his name in the *General Electric Review* for July, 1928, 100 structures were mentioned, including bridges, buildings, cars, cranes, frames and towers, ships, tanks, and so on, and, according to the revised figures, that total is now 138. In the list of a year ago the number of welded buildings was 43 and the present total is given as 65. If to that total are added bridges and ships, the total is 95, as against 63 a year ago, each item having increased by the same percentage.

An Electric Farm Exhibit.

One of the features of the International Exhibition which is to be held at Liége next year will be an electric farm in which an endeavour will be made to demonstrate the varied uses of electricity in agricultural work.

A Large Electric Sign.

What is stated to be the largest electrically-illuminated sign in Germany has lately been erected at the Klingenburg power station in Berlin by the Berlin Electricity Supply Co. The sign, which embraces only the word "Bewag," the initials of the company's title, is 147 ft. long by 65 ft. high; several thousand electric lamps are used to form the letters.

Appointments Vacant.

Mains foremen for Manchester Corporation. Teacher of electrical engineering at Jarrow secondary school, for Durham County Council. Probationary engineer in the Posts and Telegraphs Department of the Federated Malay States. Electrical engineer in the tramway department of the L.C.C. Resident engineer at the Barton power station of the Manchester Corporation. Probationary assistant engineers and inspectors in the Engineering Department of Post Office. (See our advertisement pages to-day.)

A New Use for Batteries.

The accompanying illustration shows a battery of 54 cells having a capacity of 500 amp.-hrs. at the 5-hour rate, mounted on a lorry, together with the necessary switchgear, ready for transport to Carlisle to operate the totalisator used for betting on the results of horse races. Six of these batteries have been

supplied to the Racecourse Betting Control Board, and they will travel round the country from meeting to meeting. In the case of the totalisator used at Carlisle, 10,000 lamps are used to indicate the numbers. This is another instance of the ubiquity of the modern storage battery, and it is significant that for this purpose "Kathanode" batteries manufactured by the D.P. Battery Co., Ltd., at Bakewell, Derbyshire, have been selected.

Anti-vibratory Rubber.

A reprint from the June issue of the bulletin of the Rubber Growers' Association deals with an interesting report on the anti-vibratory properties of rubber. While the investigation was primarily undertaken in connection with the use of rubber for isolating wireless sets, the results are applicable in a wider field and will appeal not only to wireless manufacturers, but also to consulting engineers, manufacturers of scientific instruments, gramophone manufacturers, dynamo manufacturers, and others interested in the elimination of vibration and noise.

Restaurant Electrical Equipment.

Few visitors to Newcastle fail to acquaint themselves with Rinaldos, the new restaurant designed and furnished on modern lines. The whole of the fittings for the lighting installation, the refrigeration equipment, the lifts and the internal telephone system, have been supplied by the General Electric Co., Ltd., and the contractors, Messrs. G. B. Carnegie and Co., have taken the fullest advantage of the technical facilities offered by the G.E.C. in carrying out their contract. "Pearl" lamps figure in the grill room, in the basement, in the restaurant on the ground floor, and above in the ball room, and the fittings which house them comprise central suspension electroliers and several demi-coupe wall brackets—typical examples of the finest "Perlique" glassware. The distinctive feature of this type of fitting, apart from the chased metal work employed in its construction, is the diffusive quality of the tinted glassware. The lighting effects therefore throughout the restaurant, being uniformly diffused and entirely without glare, impart the necessary note of comfort and allurement. The refrigeration equipment at Rinaldos is above the average. It consists of two separate plants, one No. 3 A-S, and one No. 2a A-S machines, for food storage and a wine cellar, respectively. The No. 3 plant is tucked away in otherwise useless space in the roof, and performs the dual purpose of automatically controlling the temperature of the food store and also working a 4½-gallon ice-cream-making equipment, to which is added an ice-cream conservator. In the latter is contained, at the desired low temperature, a constant supply of ice-cream. The No. 2 plant operates the wine and beer storage (390 cu. ft.) and also an ice maker, producing 1 cwt. of block ice per batch as and when required. To facilitate the service at Rinaldos no less than six electric lifts have been installed by the Express Lift Co. (one is designed as a passenger lift, and the others as service lifts), while an efficient system of intercommunication telephones has also been put in.

Electricity in Rural Areas.

The desire of the Government authorities to facilitate the extension of electricity supply in rural areas was emphasised at an official inquiry, which was held at Hatton, near Derby, on August 1st by Lieut.-Col. Tucker, on behalf of the Ministry of Transport, into an application by the Notts and Derbyshire Electric Power Co. for compulsory powers in respect to wayleaves. He pointed out that it was desired to expedite the work in various directions, and it was hoped that landowners would assist by their co-operation to effect that object. At the same time they were determined that any interference with the amenities of properties should be avoided. The application in this case had reference to the company's desire to erect an overhead line from its station at Spondon to Hatton. Thirty-eight landowners were affected, but with only two had the company been unable to arrive at a settlement as to wayleaves. They were Mrs. Gurney, upon whose land at Elvaston it was proposed to erect four poles, and Mr. Schofield, upon whose ground at Hatton Hay it was desired to place 16 poles. Against these owners compulsory powers were sought. Although Mrs. Gurney had raised an objection, there was no appearance on her behalf in support of it. Mr. Schofield suggested that in order to preserve the amenity at Hatton Hay the cable should be placed underground there, but Mr. A. D. Phillips, manager of the company, said that would treble the cost. Mr. Schofield further suggested that the amount offered for the wayleave, 25s. in all for the 16 poles, was entirely disproportionate to the advantage to be derived by the company.—The Inspector upon that point said that the amount of revenue which the company could hope to derive from the supply of electricity could not be large in a district so sparsely populated. Moreover the extension of a supply would considerably enhance the value of the property. At the close of the inquiry the Inspector visited the two areas affected.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

The Bath Electricity Committee has increased the salary of Mr. P. R. Morris from £365 per annum to the maximum of £400.

Mr. W. S. Johnston, electrical engineer to the Dumfries Town Council, who is leaving to become borough electrical engineer at St. Helens, was entertained at dinner on July 24th by members of the Dumfries Council and other prominent residents. On behalf of the company, Mr. W. J. Kelly, convener of the Electricity Committee, presented Mr. Johnston with a silver salver.

The Leeds Tramway Committee recently selected five applicants for the post of traffic superintendent, at a salary of £600 per annum, for interview. It also decided to interview seven applicants for the position of chief assistant to the rolling stock engineer at £500 per annum.

The Brighton Town Council has increased the salary of Mr. F. N. Hudson, deputy tramway engineer and manager, from £478 to £525 per annum.

The Shrewsbury Town Council has approved an increase in the salary of Mr. C. M. Johnston, the borough electrical engineer, from £600 to £700 per annum. A tribute was paid to Mr. Johnston's work for the Council over a period of 30 years.

Among the members of the Advisory Committee under the Colonial Development Act are Sir Basil Blackett (chairman of Cables and Wireless, Ltd.), chairman, and Sir Felix Pole (chairman of Associated Electrical Industries, Ltd.).

Mr. Sydney C. Hutton, of the Telegraph Department, G.P.O., Dundee, has been appointed assistant traffic superintendent in the G.P.O., Glasgow, and will take up his new duties at an early date.

Mr. E. W. Carline Day has resigned his position of assistant mains and consumers' engineer to the Leatherhead and District Electricity Co., and has accepted an appointment as mains assistant with the Borough of Fulham Electricity Department. There were fifty applicants for the position.

In the Lord Mayor's Parlour at Sheffield Town Hall on July 30th, the Lord Mayor presented to Mr. S. E. Fedden, former manager of the electricity department, an illuminated copy of the resolution of the Council expressing appreciation of his valuable services. Councillor Snelgrove, chairman of the Electricity Supply Committee, presided. The Lord Mayor said that Mr. Fedden had been connected with the department for 29 years, and on behalf of himself and the committee he wished him success in his new sphere of work as district engineer for the Mid-East England Electricity Scheme under the Central Electricity Board.

The Morecambe Electricity Committee recommends that the salary of the borough electrical engineer (Mr. M. J. Mortimer) be increased by £100 for the forthcoming year, and subsequently by two additional annual increases of £50 each.

Mr. A. J. Waring, borough electrical engineer for Newark, has been appointed as borough electrical engineer at Felixstowe. Mr. Waring went to Newark from Torquay about two years ago.

According to the Press, Sir Max Muspratt was last week lying ill at his home in Liverpool.

Mr. H. D. Phelps, A.M.I.E.E., who has been resident engineer at Thirsk for the Northern Counties Electrical Supply Co., Ltd., has left to join the headquarters staff at Newcastle to assist in developing the electro-farming side of the business. Before leaving Mr. Phelps was presented with a handsome chiming clock in oak, subscribed for by the employés of the power stations at Thirsk and Malton. Mr. J. Bradley spoke on behalf of the Thirsk staff and Mr. A. E. Squire for the staff at Malton.

We reproduce herewith a portrait of Mr. E. W. Dickinson, who, as we stated last week, has been appointed to act as technical officer in connection with the development of electricity in rural areas. Mr. Dickinson was born at Ulverstone, Lancs., in 1872, and was educated at the Manchester Grammar School and Bradford Technical College. He subsequently served an apprenticeship with Mr. J. H. Rider in Halifax.

From 1893 until the following year he was with the Corlett Electrical Engineering Co., and then he went to Bolton as assistant engineer at the Corporation electricity works. He left Bolton in 1896 to become engineer and manager of the Trinidad Electric Lighting and Power Co., and two years later joined the British Electric Traction Co. as chief assistant power engineer, subsequently becoming chief assistant to the consulting engineer and rolling stock engineer. He joined the L.C.C. Tramways Department in 1903, and resigned from the position of power station engineer in 1924 to engage in private practice. In 1926 he became private technical assistant to Sir John Snell, chairman of the Electricity Commissioners, a position which he is now relinquishing for his new task. In his earlier years, and while he was with the British Electric Traction Co., Mr. Dickinson had considerable experience of distribution work.

Elliott & Fry] *[London.*

Mr. E. W. Dickinson.

The new Technical Officer for Rural Electrical Development.

Obituary.—Mr. J. S. THOMSON.—We regret to learn that Mr. James S. Thomson, M.I.E.E., manager of the Fife Electric Power Co., passed away on July 29th, having been suddenly taken ill while on duty. He joined the company upon its formation 24 years ago, having previously held a similar appointment in South Wales. He leaves a widow and four children.

E. BERLINER.—We regret to learn that Emile Berliner passed away last week in New York at the age of 78 years. He was born in Hanover in 1851 and removed to the United States in 1870. He is chiefly known to fame as a pioneer inventor in the telephone field. Taking an interest in scientific subjects, he learnt of the invention of the telephone by Bell, and conducted some experiments, which resulted in the invention of a telephone of new form. For this he applied for patent protection in 1877. As Bell's telephone, in its first commercial form, consisted of identical instruments for transmitter and receiver, so Berliner devised apparatus consisting of a diaphragm in pressure contact with a ball and forming part of a battery circuit. One was used as the transmitter, the other as the receiver. The application was subsequently divided into two patents—one for the transmitter, the other for the receiver. The former was the cause of a great deal of litigation after it had been "in interference" for many years. It is as the inventor of the transmitter that Berliner's name has been as familiar as household words in telephone circles. He has been described as "the inventor of the microphone," because the operation of his transmitter depended upon variations of contact pressure. The discovery of the microphone is due to Professor Hughes, whose simple apparatus and clear description made plain the principles underlying microphonic action. Berliner's patent was acquired by the predecessors of the American Telephone and Telegraph Company, and Berliner himself entered their service in the department which might be described as the embryo of their vast research department of to-day. He is credited with having been instrumental in the production of the very hard carbon which largely contributed to the success of the Blake transmitter. Later Berliner turned his attention to improvements in Edison's phonograph, and was interested in a number of projects of a more or less scientific character.

Mrs. E. M. BARNETT. — We learn with regret that Mrs. E. M. Barnett, senior cooking and heating demonstrator to Metro-Vick Supplies, Ltd., passed away on Wednesday afternoon, July 31st, after an illness of a few days' duration. Mrs. Barnett, who had been with the company mentioned a number of years, was an extremely capable woman, who had a most lovable personality, and was universally liked by those with whom she was brought in contact. She will be deeply missed.

Dr. E. S. BIELER.—*The Times* reports the sudden death in Australia of Dr. Etienne S. Bieler, Deputy Director of the Imperial Geophysical Experimental Survey. He was born in Switzerland on February 3rd, 1895. Our contemporary says that Dr. Bieler had atained an authoritative position to modern methods of geophysical survey, particularly on the electrical side.

KARL AUER, RITTER VON WELSBACH.—A *Times* dispatch from Vienna reports the death at he age of 70 years of Karl Auer, Ritter von Welsbach, inventor of the incandescent gas-lamp mantle, a type of electric lamp filament, and other important devices.

The death of Mr. C. H. MCCARTHY, general manager of the Indian Radio Telegraph Company, is reported from Bombay.

Will.—The late Mr. EDWARD HORNIDGE, Lower Bourne, Farnham, who was connected with the Buckingham Electric Light Co., left £6,987 gross (£4,382 net personalty).

Financial Section.

New Companies, Returns of Share Capital, Debenture Charges, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

G. M. Paterson & Logan, Ltd.—Private company. Registered in Edinburgh on July 26th. Capital, £600 in £1 shares. Objects:—To carry on the business of distributors of all kinds of wireless and electrical goods, commission agents, merchants, warehousemen, &c. The subscribers (each with one share) are:—R. Logan, "Knocknair," Kilbirnie, retired school teacher; J. Logan, "Knocknair," Kilbirnie, wireless representative. The first directors are not named. Registered office: 122, West Campbell Street, Glasgow, C.2.

A. J. Dean & Co., Ltd.—Private company. Registered July 29th. Capital, £1,000 in £1 shares. Objects:—To carry on the business of electrical and wireless engineers, builders and decorators, workers in metals, contractors for the supply of electrical plant, &c. The directors are:—A. J. Dean (permanent director and chairman), 77, Congreve Road, Eltham, S.E.9; A. D. Dean, 77, Congreve Road, Eltham, S.E.9; J. Taylor, 275, Westmount Road, Eltham, S.E.9. Registered Office: 164, Eltham High Street, S.E.9.

British Electrical Trust, Ltd.—Registered as a public company July 31st. Capital, £100 in £1 shares. Objects: To acquire and turn to account shares, securities and obligations of any corporation or company carrying on or authorised to carry on business as generators, suppliers, or distributors of electricity, or as manufacturers of or dealers in machinery, articles and apparatus used for the equipment of electrical generating

stations, or for the purpose of, or in connection with, the generation, distribution, supply, accumulation and employment of electricity; to generate, supply and distribute electricity for light, heat, power and other purposes, to construct and equip generating stations, and lay down and provide cables, lines, other works, &c. The first directors are: Sir Walter J. Halsey, Bt., Gaddesden Place, Hemel Hempstead, solicitor; A. G. Halsey, 1, Melina Place, St. John's Wood, N.W., solicitor; G. B. Downs, 52, Princes Park Avenue, Golder's Green, N.W.11, solicitor's managing clerk. Secretary: W. H. Townsend. Registered office: 32, St. James's Place, S.W.1.

Dunhams, Ltd.—Private company. Registered July 31st. Capital, £15,000 in 10,000 7½ per cent. participating preference shares of £1 each and 20,000 ordinary shares of 5s. each. Objects: To acquire the business of a wireless manufacturer carried on by C. S. Dunham at Elm Works, Elm Park, Brixton Hill, S.W.2, and to carry on the business of manufacturers of or dealers in radio or gramophone apparatus, &c. The permanent directors are: C. S. Dunham, 37, Francis Road, Kenton, nr. Harrow; J. E. Macpherson, 41, Connaught Road, N.W.10; H. C. Blaxland, 26, Stanhope Gardens, Highgate, N.6; V. L. Hawker, 20, York Buildings, Adelphi, W.C.2. Registered office: Elm Works, Elm Park, Brixton, S.W.2.

Ellison Insulations, Ltd.—Private company. Registered July 31st. Capital, £15,000 in £1 shares. Objects: To carry on the business of manufacturers and producers of, or dealers in, electrical and thermal insulating materials, organic and inorganic plastic materials or mixtures, mixtures or combinations of paper, cloth, fibrous, cellular, or pulverous materials with synthetic resinous substances, ceramic goods and cements, varnishes, paints and adhesives, and articles of all kinds moulded, pressed, cast or otherwise from the said materials and substances and to adopt an agreement with George Ellison, Ltd. The subscribers (each with one share) are: G. Ellison, Flint Green House, Acocks Green, manufacturer; T. G. Ellison, Flint Green House, Acocks Green, engineer; G. Ellison, jnr., 14, Brueton Avenue, Solihull, engineer. G. Ellison shall be governing director providing that within six months of the incorporation of the company he shall acquire three-quarters of the issued ordinary shares. Qualification of ordinary directors: £100 ordinary shares. Registered office: Wellhead Lane, Perry Bar, Birmingham.

Shock Proof, Ltd.—Private company. Registered July 30th. Capital, £2,000 in £1 shares. Objects: To acquire from R. Lomax the benefit of certain existing inventions in relation to the production of electricity service boxes, to adopt certain agreements, and to carry on business as manufacturers of and dealers in lampholders, &c. The first directors are: A. Mugeli, Marsden House, High Lane, Hazel Grove, retired manager; R. Lomax, Brook Villa, Whitefield, Heaton Norris, electrical engineer. Solicitor: A. E. Grundy, 2, John Dalton Street, Manchester.

Wood Fittings & Standards, Ltd.—Private company. Registered July 30th. Capital, £5,000 in £1 shares. Objects: To acquire the business of manufacturers of electric light fittings carried on at 66, Charlotte Street, W., and 3, Bedford Passage, Charlotte Street, under the respective titles of the Wood Fittings Co. and the Wood Standards Co. The first directors are: E. May, Hadlow, Woodlands Road, Bickley, engineer; H. J. Upton, 7, St. George's House, Coptic Street, W.C.1, engineer. Registered office: 66, Charlotte Street, W.

Electrafont, Ltd.—Private company. Registered August 1st. Capital £100 in £1 shares. Objects: To carry on the business of electric water heater manufacturers, ironfounders, mechanical engineers, toolmakers, brassfounders, electrical engineers, &c. The subscribers (each with one share) are:—H. C. Taylor, 53, Park View Crescent, N.11, incorporated accountant; E. E. Shorter, 18, Wharf Road, City Road, N.1, electrician. The first directors are not named. Solicitors: Jenning, Son & Ash, 69, Leadenhall Street, E.C.3.

Official Returns of Electrical Companies.

W. H. A. Robertson & Co., Ltd.—Satisfaction to the extent of £100 on March 26th, 1928, and to the extent of £100 on March 25th, 1929, of mortgage dated June 17th, 1926, securing £1,200.

Radio Vacuum Cleaners, Co., Ltd.—Debenture dated July 17th, 1929, to secure all moneys due or to become due to the chargees, charged on agreements for sale of vacuum cleaners or other chattels deposited with the Equipment Trust Co., Ltd., or with the lenders and the chattels comprised therein, and the company's undertaking and property, present and future, including uncalled capital if any (subject to charge in favour of the above Trust). Holders: Finance Trust & Agency Co., Ltd., 4, Crosby Square, E.C.3.

Croydon Engineering Co., Ltd.—Particulars filed of £12,000 debentures authorised June 13th, and covered by trust deed dated July 18th, 1929, charged on the company's undertaking and property, present and future, including uncalled capital, land, and No. 80, Gloucester Road, Croydon, the whole amount being now issued. Trustees: G. R. Thursfield and P. K. Noad.

Franklin Ebonite Co., Ltd.—Particulars filed of £500 debentures authorised July 12th, 1929, charged on the company's property, present and future, including uncalled capital, the amount of the present issue being £70, also issue on July 19th of £75 debentures, part of above series.

Furneaux & Thomas, Ltd.—Debenture dated July 16th, 1929, to secure £800, charged on the company's property, present and future, including uncalled capital. Holder: F. E. Bendall, 35, Windsor Place, Cardiff.

City Notes.

Perak River Hydro-Electric Power Co., Ltd.

Last week a progress report was circulated to the holders of the company's shares and debentures. This stated that the work on the Chenderoh dam and power station is progressing satisfactorily and the programme calling for the completion of the works by the end of March, 1930, is being well maintained. The erection of the first two turbines and generators is proceeding satisfactorily. Certain unforeseeable engineering difficulties in connection with coffer dam No. 1 were overcome, but additional capital expenditure was involved. The steam station has been in operation since December 12th, 1928, and the load has risen from 1,750 kW at the beginning of January to 5,088 kW at the beginning of July; it is expected that it will reach 12,000 kW (corresponding to an output of 72 million kWh per annum) by the end of the year. The 6,000-kW extension (making 18,000 kW in all) has been erected expeditiously. At June 30th contracts had been signed for 30,056 kVA and further contracts for 13,000 kVA were under negotiation. These figures indicate that the combined hydro-electric and steam stations will be fully loaded very soon. To finance the extension of the steam station, authority was obtained in June for the issue of an additional £250,000 of 7 per cent. participating debenture stock to existing stockholders. It is proposed to make the issue in October. The consulting engineers state that the total additional expenditure to complete the engineering works will not exceed £350,000. The additional sum is necessitated partly by the extra work on the dam mentioned above; partly by additional transmission lines; and partly by sundry increases in the cost of machinery over the estimates. To finance the increased expenditure the board proposes to call a meeting of shareholders in October and lay proposals before them. In conclusion, the directors state that it will probably be necessary for them to consider the installation of further steam plant when the Chenderoh development is completed. This would raise the generating capacity from 160 million to about 230 million kWh per annum.

Einstein's Electro-Chemical Process, Ltd.

At an extraordinary meeting on July 30th a resolution was passed increasing the capital of the company by creating 520,000 ordinary shares of 4s. each. Colonel The Master of Sempill (chairman), who presided, said that the new shares would be allotted to the vendors of the Pigache process, which the company was acquiring. That process had considerable possibilities, not only so far as it applied to the Einstein process, but in a variety of different directions. The progress made with the company's factory at Slough was satisfactory, and negotiations were proceeding satisfactorily for the sale of the company's rights and for the sale of licences. A contract had been arranged whereby Messrs. Charles Tennant & Sons would take the company's entire output of sulphur and copper carbonate. Sir George Thurston and Mr. E. Spyer had joined the board.

Yorkshire Electric Power Co.

The directors' report for the half-year ended June 30th last states that the demand has shown an increase as compared with the first half of 1928, but the improvement in trade within the company's area has only been moderate. The Mid-East England Electricity Scheme adopted by the Central Electricity Board includes the company's area of supply and provides for the use of the company's stations as "selected" stations. The company has been granted an Order to supply in Hope, Derbyshire, and the overhead mains are being extended to meet substantial demands for electricity in the area. The Electricity Commissioners have intimated their intention to grant the Isle of Axholme and District and the Yorkshire Electric Power Eastern Extension Electricity Special Orders. As we have already reported, the ordinary dividend for the half-year is at the rate of 6 per cent. per annum.

Young Accumulator Co. (1929), Ltd.

Mr. E. H. F. Reeve, the chairman, presided at the company's statutory meeting on July 29th, and in the course of his speech said that the equipment of the new factory at

Malden was well advanced, and manufacture had actually commenced. It was anticipated that the old factory would be closed down during August. The cost of equipping the new factory would be well below £20,000, the estimated figure. The company had recently secured a licence for the manufacture and use of the Wilderman separator, which would still further improve the efficiency of the accumulators. They were actively engaged in appointing additional agents at home and abroad; they were confident that they would obtain a large proportion of the great demand for storage batteries when their factory was in full working order.

British Power and Light Corporation (1929), Ltd.

The statutory meeting was held last week. Captain C. E. Benson, D.S.O. (who presided in the absence of the chairman, Mr. H. A. Vernet) said that the period which had elapsed since the formation of the company had been occupied principally in consolidating the management and operation of the various subsidiary companies. That process had naturally caused a certain amount of readjustment in functions of the various parts of the subsidiary companies, but everybody was fitting into his proper place and carrying out his own functions in the very considerable organisation which the corporation represented.

Electricity Distribution of Yorkshire, Ltd.

The report for the six months ended June 30th records a substantial increase in the sales of energy for all purposes. It is stated that the Blyth (Notts.) and District Electricity Special Order now awaits confirmation. An issue of 600,000 £1 shares at 25s. each was made in March, and was applied for more than twice over by the shareholders; the issued capital is now £1,400,000. The dividend for the half-year is at the rate of 9 per cent. per annum.

Associated Gas and Electric System.

The gross earnings of the companies comprising this system during the year ended May 31st last totalled $57,140,821, against $42,006,909 in 1927-28. The net earnings rose from $18,167,902 to $26,013,699, and the balance available after meeting interest charges and providing for replacements, renewals, etc., was $8,224,755, against $6,101,892.

Canadian Marconi Co.

The net profit for the past year rose by $135,035 to $181,590. It is stated that although the Canadian company was not included in the wireless-cable merger, the merger company has a substantial interest in it, and arrangements are being made for close co-operative working.

Vickers, Ltd.

The directors have declared the following interim dividends for the half-year ended June 30th:—2½ per cent. on the preferred 5 per cent. stock; 2½ per cent. on the 5 per cent. preference shares; and 2½ per cent., free of tax, on the cumulative preference shares.

Davis & Timmins, Ltd.

An interim dividend at the rate of 8 per cent. is recommended on the ordinary shares (against 3½ per cent. last year). The directors state that the increase is made to bring the interim more in accord with the final dividend.

Wellman Smith Owen Engineering Corporation, Ltd.

The report for 1928 shows a net loss of £4,063, which was reduced by £300 by taxation recovered. To this was added a loss brought forward of £10,878, leaving a debit balance carried forward of £14,640.

Prospectus.

Allen, West & Co., Ltd.—This company has published in the daily Press particulars of financial and other details in accordance with the Regulations of the Stock Exchange.

Hydro-Electric Securities Corporation.

A quarterly dividend of 25 cents per share has been declared on the common stock.

Power Corporation of Canada.

A 5 per cent. stock dividend has been declared, payable on October 25th.

Rushden and District Electric Supply Co., Ltd.

The directors have declared on interim dividend of 3½ per cent, on the share capital, payable August 22nd.

Northampton Electric Light and Power Co., Ltd.

The directors have declared an interim dividend of 4 per cent. on the ordinary shares.

Stocks and Shares.

TUESDAY EVENING.

IN accordance with the custom that has been followed for a good many years, with few exceptions, in the ELECTRICAL REVIEW, the August Bank Holiday week is once more taken as being a useful point at which to compare Stock Exchange prices of the moment with those that ruled at the beginning of the year. Business in the Stock Exchange is quiet at this season, and company work, in the way of dividend declarations, &c., is cut down as much as possible. At the present time, the prevailing trouble is dearness of money. This, more than anything else, weighs upon the prices of stocks and shares. It must be remembered that at the beginning of this year the Unionist Government were in power, and, although most impartial authorities agreed that the issue of the General Election, so soon to be held, was a very open one, the actual figures caused a certain amount of surprise. The new Government has been unfortunate in attaining power at a time when financial conditions at home and abroad proved particularly difficult. It must be added that the Government's policy has done nothing to make matters easier for the holders of shares in home industrial companies.

Causes and Effects.

The intention of the Government in regard to safeguarding, for instance, has yet to be made clear, but the expectation that the policy is likely to be modified, if not altogether abolished, has caused depression in the prices of shares in companies which stand to be affected by the withdrawal of the Safeguarding Acts. Moreover, industrial disturbances have followed quickly upon the advent of the new Cabinet to power.

In the circumstances, it is hardly surprising to find that capital has been disposed to seek employment in stocks and shares of companies outside Great Britain. A violent boom in Canadian, American, and Mexican Utility shares has aroused attention over here, and has brought about a series of very substantial improvements in the shares of undertakings connected with the Americas. The most spectacular rise of all, however, is that secured by British Electric Traction Deferred stock, owing in no small part to the linking-up of certain of the company's interests with those of the London & North-Eastern Railway.

Electricity Supply.

Taking, first of all, the list of shares in electricity supply companies, it will be noticed that most of the movements are comparatively slight:—

ELECTRICITY SUPPLY SHARES.

Ordinary.	December 31st, 1928.	Now.		Rise or fall.
Brompton	27s. 0d.	26s. 0d.	–	1s. 0d.
Charing Cross ...	26s. 6d.	26s. 6d.		—
Chelsea	27s. 0d.	26s. 0d.	–	1s. 0d.
City of London ...	30s. 9d.	33s. 3d.	+	2s. 6d.
County	44s. 6d.	53s. 6d.	+	9s. 0d.
Kensington	26s. 6d.	26s. 0d.	–	0s. 6d.
London	26s. 0d.	28s. 0d.	+	2s. 0d.
Metropolitan ...	46s. 3d.	43s. 9d.	–	2s. 6d.
St. James's ...	27s. 6d.	26s. 6d.	–	1s. 0d.
South London ...	27s. 6d.	26s. 6d.	–	1s. 0d.
Westminster ...	27s. 0d.	26s. 0d.	–	1s. 0d.

On balance, the tendency has been easier in the cases of those companies the prices of whose shares are swayed more by considerations of the money market than by those of industry. On the other hand, County of London Ordinary have enjoyed a substantial improvement, it being expected that the company will make a new issue of shares on bonus terms. Metropolitans have gone back, and this in spite of buying that is said to have originated in the United States. Some of the provincial power shares are better: Midland Counties, for instance, having started the year at 30s., being now 31s. 6d. On the other hand, Bournemouth and Poole have come down from 67s. 6d. to 63s. 3d., after having been, at one time, below £3.

Home Railway Stocks.

The Home Railway market has proved disappointing to stockholders, and movements in the active stocks are mostly downwards. Underground Electric Income Bonds have dropped 19 points, and the shares 4s. 6d. This was because the new Government have taken up a hostile attitude to the London Traffic Bill, which is now thought likely to be in danger of not passing. The following comparisons show the movements in five of the leading stocks:—

RAILWAY STOCKS AND SHARES.

Stock or Share.	December 31st, 1928.	Now.		Falls.
Central London Ordinary	73	72	–	1
Metropolitan	65	56½	–	8½
District	80½	72½	–	8
Underground "A" ...	26s. 6d.	22s. 0d.	–	4s. 6d.
Underground Income ...	126	107	–	19

Telegraphs and Telephones.

Amongst telegraphs and telephones, the outstanding feature has been the interest shown in the amalgamation of the three cable companies—Eastern Telegraph, Eastern Extension, and Westerns—with the Marconi Wireless Company. Out of this amalgamation has grown Cables and Wireless, Limited, a market in whose three stocks started on July 7th. There are now 5½ per cent. preference, 7½ per cent. "A" ordinary, and a "B" ordinary stock to which no fixed dividend is attached. It is generally expected that the Merger will pay a dividend of 5 or 6 per cent. on the 7½ per cent. "A" ordinary stock, in respect of its first year's working, because expenses are certain to be heavy, even if the Inland Revenue authorities should consent to waive any part of their claim for stamp-duty, on account of the new amalgamation being in the nature of a national undertaking. In the following table, the prices of the Cable stocks are set out, matched against the equivalent at which the Cables and Wireless issues stand to-day, and as set out in our table of prices :—

Stock or Share.	December 31st, 1928	Now		Rise or fall.
Anglo-American Pref. ...	103½	103	–	½
Eastern Extension ...	26¾	27*	+	¼
Eastern Telegraph ...	26⅞	27⅛*	+	⅜
Globe Ordinary	25½	26	+	½
Great Northern	34½	31	–	3½
Indo-European	47½	47½		—
Marconi	78s. 9d.	3¾*	–	3/16
Western Telegraph ...	26¼	27⅛*	+	¼

Amongst other telegraph stocks, no special changes stand out conspicuously. American Telephone and Telegraph started this year at 187½, and now stand 100 points higher. International Telephone and Telegraph was 197 on New Year's Eve, and the present price of 112½ shows a nominal fall by reason of rights that have been distributed during the interval.

Utilities.

In a mixed list of utility stocks and shares, it will be noticed that the prices of Canadian, American, and Mexican issues have developed a surprising degree of strength. It may be considered one of the outstanding financial features of the year that Americans should have gone ahead at such a pace. The buying has been not entirely on behalf of New York and Montreal. On several occasions, however, the speculation in these two centres have run so high as to call for action on the part of American and Canadian Banks, who protested that the money being utilised in speculation was diverted from trade channels, to the detriment of national industry. They claimed that this speculation should be checked, and made half-hearted efforts to back up their protests by increasing the rates for money. Nobody paid more than passing attention to these efforts, and, as a result of the boom, prices of Utility stocks have been run up to remarkable figures. A few are set out in the following list :—

Stock or Share.	December 31st, 1928.	Now.		Rise or fall.
Atlas Light and Power ...	20s. 0d.	27s. 0d.	+	7s. 0d.
Brazilian Tractions	77½	68½	–	9
British Electric Traction Def'd.	615	1,650	+	1,035
Canadian General	132½	310	+	177½
Consolidated Baltimore ...	94½	140	+	45½
Mexico Tramways	47½	58½	+	11
Mexican Light and Power ...	77½	95	+	17½
Montreal	111	121	+	10
Perak River	18s. 0d.	15s. 0d.	–	3s. 0d.
Shawinigan	89½	97	+	7½
Victoria Falls	58s. 9d.	60s. 0d.	+	1s. 3d.
Pennsylvania	84½	114½	+	30

Amongst the cable and electrical equipment descriptions, the main feature of the past seven months was a doubling of the price in General Electric ordinary shares. American purchases ran up the quotation to what appeared an unjustifiable level. The company's proposals for the issue of new shares, and the developments that resulted therefrom, are too fresh in everyone's memory to warrant more than this passing reference. On the year, G.E.C. shares are 7s. 6d. up. Wild fluctuations have occurred in Associated Electrical Industries shares; the present price is 2¼. Half-a-dozen representative examples are here illustrated :—

	December 31st, 1928.	Now.		Rise or fall.
Babcock	3½	3¼	–	⅛
British Aluminium ...	45s. 0d.	47s. 0d.	+	2s. 0d.
Callender's	4 1/16	3¾	+	5/16
General Electric	43s. 9d.	51s. 3d.	+	7s. 6d.
Henley's	5⅞	6⅛	+	⅛
India-rubber	11s. 3d.	13s. 9d.	+	2s. 6d.

The decline in Callender's is apparent and not real; new shares have been distributed, during the iterval, and these represented a bonus. Heaviness in iron and steel issues is due to the uncertainty surrounding politics. The rubber share market has pursued a placid, uninteresting path for the greater part of the time. Stock Exchange business on the whole has been very much quieter during the past seven months than it was in the corresponding portion of 1928.

* To-day's equivalent of Cables and Wireless stocks.

Share List of Electrical Companies.

Home Electricity Companies.

	Nom. £	Approx. Dividend. 1927.	1928.	Price Aug. 6 1929.	Rise or fall	Yield p.c.
Bournemouth and Poole	1	15	15	33/3	+2/9	4 15 0
Brompton Ordinary	1	8½	8½	26/-	—	6 7 8
Charing Cross Ordinary	1	8½	8½	25/6	—	6 6 8
do. do. 4½% Pref. ...	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8¾	8¾	26/-	—	6 7 8
City of London	1	10	10	33/3	—	4 4 6
do. do. 6% Pref.... ...	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	26/3	—	... ...
County of London	1	7½	10	53/6	+6d.	3 15 3
do. do. 6% Pref.... ...	1	6	6	23/-	—	5 4 4
Edmundson's 7% Pref.	1	7	7	24/-	—	5 16 8
Elec. Supply Corporation	1	11	11	53/3	—	4 3 8
Kensington Ordinary	1	8	8	26/-	—	6 7 8
Lancs. Light and Power	1	7½	7½	28/-	–3d.	5 7 2
London Electric	1	8½	9	28/-	—	5 0 9
Metropolitan	1	9	9	43/9	—	4 2 3
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	6½	6½	31/6	–6d.	4 2 6
Mid. Elec. Power	1	15	8	37/6	—	4 5 4
Newcastle-on-Tyne Ordinary ...	1	6	6	27/-	—	4 9 0
do. 7% Pref.	1	7	7	26/-	—	5 7 8
Notting Hill 6% Pref.	10	6	6	11	—	5 9 1
North Met. Elec. 6% Pref. ...	1	6	6	23/-	—	5 4 4
St. James' and Pall Mall	1	8	8	26/6	—	5 5 8
Scottish Power	1	8	8	30/-	—	5 6 8
South London	1	8½	8½	26/6	—	5 5 8
Urban Ordinary	1	7	—	37/-	—	... ...
Westminster Ordinary	1	8½	8½	26/-	—	5 7 8
Whitehall Elec. Invst. 7½% Pref. ...	1	7½	7½	24/6	—	6 3 5
Yorkshire Elec.	1	8	8	36/-	—	4 9 0

Home Rails.

Central London Ord. Assented ...	Stock	4	4	72	—	5 11 1
Metropolitan	,	8	8½	£6½	–¼	6 4 9
do. District ... ... ,,	4	5	72½	—	6 18 9	
Underground Electric	£1	5	7	22/-	+6d.	6 7 9
do. do. Income ...	Bonds	6	6	107	+1	5 12 9

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	Stock	6	6	103	—	5 16 8
do. Def. ... ... ,,	1¼	1½	24½	—	6 4 5	
Automatic Telephone	1	10	12½	2	—	6 5 0
Cables & Wireless Pref.	Stock	—	—	95xd	+½	... ...
do. A Ord. ... ... ,,	—	—	87	—	... ...	
do. B Ord. ... ... ,,	—	—	80½	–1	... ...	
Globe Tel. and T. Ord.	10	10	10	26	—	*3 17 0
do. do. Pref.	10	6	6	11½	—	5 5 6
Great Northern Tel.	10	20	17½	31	—	5 13 9
Indo-European	25	10	10	47½	–1½	*5 5 8
Marconi-Marine		12½	15	3⅛	+⅛	4 10 8
Oriental Telephone Ord.		12	12	8⅛	—	... ...

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	5½	3⅞	—	8 0 6
do. do. 2nd Pref. ...	5	6	6	3½	—	8 11 6
do. do. 5% Deb. ...	Stock	5	5	74½	—	6 14 9
British Electric Traction Def. Ord.	,,	5	5	1650	+50	... ...
do. do. Pref. Ord.	,,	8	8	198	—	6 5 0
Brazil Traction	100	7	8	68½	+½	2 18 7
Brit. Columbia Elec. Rly. Pcc. ...	Stock	5	5	£24	—	5 5 10
London & Sub. Trac. 5% Pref. ...	1	Nil	Nil	10/-	—	... ...
London United Tram Deb. ...	Stock	4	4	59	—	6 15 7
Mexico Trams, 5% Bonds ...	—	5	5	75	—	6 13 9
Mexican Light Common	100	Nil	Nil	95	–2½	... ...
do. 7% Pref.	100	7	7	81½	—	8 11 10
do. 1st Bonds	—	5	5	79	—	6 6 7
Yorkshire (West Riding)	1	Nil	Nil	5/-	—	... ...

Manufacturing Companies.

Assoc. Elec. Ord.	1	6	—	2½	+⅛	2 13 4
Babcock & Wilcox	1	12	15	69/6	—	*4 16 9
British Aluminium Ord.	1	10	10	47/-	—	*4 5 1
British Elec. Transformer Pref. ...	1	7	7	13/9	—	9 6 8
British Insulated Ord.	1	15	15	52	—	4 0 9
Brush Ord.	Stock	10	10	131	–1	7 12 3
Callenders	1	15	15	3¾	—	4 0 0
do. 6½% Pref.	1	6¾	6¾	1⅝	—	5 4 0
Crompton Parkinson Ord.	£/-	—	—	91	—	... ...
do. 8% Pref.	1	8	—	25/-	—	6 8 0
Edison-Swan 1st Pref.	1	7½	7½	24/6xd	—	7 1 2
do. 5% Deb.	Stock	5	5	84½	—	5 18 4
Electric Construction	1	7½	5¼	15/-	—	7 6 8
Enfield Cable Ord.	1	20	20	4⅜	—	4 11 4
English Electric	1	Nil	Nil	6/8	—	... ...
do. do. Pref.	1	8	Nil	7/6	—	... ...
Gen. Elec. Pref.	1	6¾	6¾	24/-	—	5 8 4
do. Ord.	1	10	10	2⅞	—	3 13 4
Henley...	1	25	30	6⅛	—	4 14 4
do. 4½% Pref.	5	4½	4½	4¼	—	5 6 0
India-Rubber	1	Nil	Nil	13/9	—	... ...
Johnson & Phillips	1	10	—	96/3	—	5 10 4
Siemens Ord.	1	7½	7½	27/-	—	5 11 1
Telegraph Construction	12	10	10	23½	—	*4 19 8

* Dividends paid free of Income Tax.

South African Electrical Trade.

Import Figures for 1927 and 1928 Compared.

THE following statement, showing the imports of electrical and similar goods into the Union of South Africa during the year 1928, has been compiled from the recently-issued official trade statistics. The figures for 1927 are added for purposes of comparison, and notes of any increases or decreases are made.

	1927. £	1928. £	Inc. or dec. £
Electrical cable and wire—			
Total	603,000	569,000	− 34,000
From Great Britain	553,000	509,000	− 44,000
„ United States	6,000	6,300	+ 300
„ Germany	32,000	39,000	+ 7,000
„ Belgium	4,000	8,400	+ 4,400
„ Holland	5,500	3,700	− 1,800
Heating and cooking apparatus—			
Total	80,000	118,000	+ 38,000
From Great Britain	34,000	38,000	+ 4,000
„ United States	10,000	18,000	+ 8,000
„ Germany	9,000	14,000	+ 5,000
„ Canada	25,000	44,000	+ 19,000
Meters, electric—			
Total	22,000	28,000	+ 6,000
From Great Britain	16,000	15,000	− 1,000
„ Germany	2,500	8,000	+ 5,500
„ United States	1,500	600	− 900
„ Switzerland	2,000	2,800	+ 800
Insulators—			
Total	10,000	7,200	− 2,800
From Great Britain	6,500	5,500	− 1,000
„ United States	2,000	1,100	− 900
„ Germany	1,000	500	− 500
Electrical material, other—			
Total	43,000	73,000	+ 30,000
From Great Britain	17,000	23,000	+ 6,000
„ United States	8,000	9,700	+ 1,700
„ Germany	4,000	8,000	+ 4,000
„ Italy	2,500	5,600	+ 3,100
„ France	1,000	800	− 200
„ Sweden	8,000	23,000	+ 15,000
Electric hand lamps—			
Total	20,000	21,000	+ 1,000
From Great Britain	2,500	2,100	− 400
„ Germany	4,500	4,300	− 200
„ United States	13,000	14,000	+ 1,000
Other electric lamps, globes, &c.—			
Total	136,000	132,000	− 4,000
From Great Britain	60,000	50,000	− 10,000
„ Austria	10,000	10,000	—
„ Germany	15,000	19,000	+ 4,000
„ Holland	30,000	32,000	+ 2,000
„ United States	11,000	11,000	—
„ Hungary	6,000	5,500	− 500
Electric lighting outfits, self-contained—			
Total	17,000	24,000	+ 7,000
From Great Britain	4,000	7,000	+ 3,000
„ United States	12,600	14,500	+ 1,900
Wireless apparatus and parts—			
Total	45,000	84,000	+ 39,000
From Great Britain	37,000	60,000	+ 23,000
„ United States	5,500	13,000	+ 7,500
„ Germany	1,000	6,300	+ 5,300
„ Holland	1,000	1,200	+ 200
Telegraph and telephone material—			
Total	41,500	52,000	+ 10,500
From Great Britain	21,000	30,000	+ 9,000
„ Sweden	5,000	7,000	+ 2,000
„ United States	6,000	6,300	+ 300
„ Germany	5,000	4,000	− 1,000
„ Belgium	3,600	4,000	+ 400
Batteries, primary—			
Total	96,000	115,000	+ 19,000
From Great Britain	17,000	24,000	+ 7,000
„ United States	63,000	78,000	+ 15,000
„ Germany	5,000	7,000	+ 2,000
„ Denmark	6,000	5,500	− 500
„ France	3,500	—	− 3,500
Batteries, secondary—			
Total	83,000	82,000	− 1,000
From Great Britain	17,000	21,000	+ 4,000
„ United States	55,000	50,000	− 5,000
„ Germany	3,000	7,600	+ 4,600
„ France	8,000	—	− 8,000
Motors—			
Total	183,000	138,000	− 45,000
From Great Britain	122,000	82,000	− 40,000
„ United States	33,000	20,000	− 13,000
„ Germany	12,000	18,000	+ 6,000
„ Holland	9,000	7,000	− 2,000
„ Sweden	2,000	2,900	+ 900
„ Denmark	4,000	4,300	+ 300
Transformers—			
Total	91,000	106,000	+ 15,000
From Great Britain	55,000	72,000	+ 17,000
„ United States	23,000	15,000	− 8,000
„ Germany	6,000	9,000	+ 3,000
„ Holland	4,000	1,800	− 2,200
Dynamos and generators—			
Total	57,000	67,000	+ 10,000
From Great Britain	49,000	58,000	+ 9,000
„ Germany	3,000	3,100	+ 100
„ United States	5,000	5,000	—
Electrical machinery, other—			
Total	990,000	877,000	−113,000
From Great Britain	762,000	655,000	−107,000
„ United States	113,000	109,000	− 4,000
„ Germany	81,000	89,000	+ 8,000
„ Sweden	9,000	7,000	− 2,000
„ Canada	8,500	1,000	− 7,500
„ Holland	3,000	4,000	+ 1,000
„ Switzerland	5,000	5,000	—
Tramway rails and materials—			
Total	49,000	23,000	− 26,000
From Great Britain	39,000	22,000	− 17,000
„ United States	8,000	1,000	− 7,000
Tramway rolling-stock—			
Total	10,000	2,200	− 7,800
From Great Britain	6,000	1,800	− 4,200
„ United States	3,500	300	− 3,200
Engines, oil, petrol and spirit—			
Total	76,000	139,000	+ 63,000
From Great Britain	54,000	97,000	+ 43,000
„ United States	15,000	28,000	+ 13,000
„ Germany	4,500	11,500	+ 7,000
„ Canada	1,000	1,000	—
Engines, steam and gas—			
Total	87,000	82,000	− 5,000
From Great Britain	82,000	76,000	− 6,000
„ United States	3,000	3,800	+ 800

In addition to the above the following goods were imported as "Government stores":—

Batteries, primary—			
Total	1,300	4,900	+ 3,600
From Great Britain	500	400	− 100
„ Germany	400	200	− 200
„ Denmark	400	3,000	+ 2,600
Batteries, secondary—			
Total	400	6,900	+ 6,500
From Great Britain	400	3,300	+ 2,900
„ Belgium	—	3,600	+ 3,600
Heating and cooking apparatus—			
From Great Britain	—	60	+ 60
„ United States	—	620	+ 620
Insulators—			
Total (mainly from Great Britain)	1,000	380	− 620
Motors and parts—			
Total (mainly from Great Britain)	120	670	+ 550
Dynamos and generators—			
Total (mainly from Great Britain)	1,000	200	− 800

	1927. £	1928. £	Inc. or dec. £
Transformers—			
Total	16,500	1,800	− 14,700
From Great Britain ...	15,000	1,800	− 13,200
,, Germany	1,500	—	− 1,500
Electrical cable and wire—			
Total	27,000	39,000	+ 12,000
From Great Britain ...	9,500	9,700	+ 200
,, Denmark	—	500	+ 500
,, Germany	14,000	24,000	+ 10,000
Electrical machinery, other—			
Total	330,000	31,000	−299,000
From Great Britain ...	289,000	25,000	−264,000
,, United States ...	500	200	− 300

	1927. £	1928. £	Inc. or dec. £
Wireless material—			
Total	700	2,500	+ 1,800
From Great Britain ...	300	2,300	+ 2,000
,, Sweden	400	100	− 300
Other telegraph and telephone material—			
Total	94,000	109,000	+ 15,000
From Great Britain ...	59,000	65,000	+ 6,000
,, United States ...	500	500	—
,, Sweden	20,000	23,000	+ 3,000
,, Germany	5,000	11,000	+ 6,000
Electrical lamps and lampware—			
Total (nearly all from Great Britain) ...	1,000	3,100	+ 2,100

Canadian Industry and Trade.

Advice to British Electrical Manufacturers.

An interesting report on financial, industrial and commercial conditions in Canada, dated April, 1929, has been transmitted to the Department of Overseas Trade by Mr. F. W. Field, Senior Trade Commissioner in Canada (Stationery Office, 3s. net). Some prefatory information gives the area of the Dominion as 3,547,230 sq. miles, and the estimated population as 9,658,000. The total imports into Canada during 1928 were valued at $1,222,317,916, of which the United States was responsible for $825,740,612, and the United Kingdom for only $190,712,351. Exports of Canadian produce had a value of $1,349,751,403, the United Kingdom's share amounting to $446,136,758, and that of the United States to $492,541,120.

In his introductory remarks, Mr. Field says that during the past four years Canadian farmers have harvested substantial crops, and last autumn they reaped the largest wheat crop in the history of the country. In British Columbia, Alberta, Manitoba, Ontario, and Quebec there has been unprecedented activity in the development of mineral resources. Among the world's producers Canada is first in nickel and asbestos, second in cobalt, third in gold and silver, fourth in lead and copper, and sixth in zinc. In 1928 Canadian copper production amounted to 100,970 tons, an advance of over a third upon the 1927 figure. In no previous period has there been such a rapid increase in manufacturing. In the absence of complete world figures for 1928, it is estimated that Canada ranks second as an exporter and fifth in total trade. The Dominion's financial position is very sound. It is calculated that last year's surplus amounted to $70,000,000, which is available for the reduction of the national debt; in the last six years the net debt reduction has been nearly $227,000,000. During the past four years bank deposits have grown by more than $500,000,000, enabling the banks to increase their loans to agriculture, industry and trade. Employment throughout Canada was at a higher level in 1928 than in any previous year.

Industrial Development and Investment.

The report states that during the last two years over 200 important expansions have been added to existing factories, and over 100 new factories have been erected. It is estimated that the total amount invested now amounts to about $4,750,000,000. The output in 1927, valued at $3,425,000,000, constituted a record. The importance of electricity in Canadian economic life is demonstrated by the fact that the class of industrial establishment having the greatest investment ($877,000,000) was the central electric power station. The closely-allied pulp and paper industry was second in the list with $579,000,000. An appendix shows that in 1927 there were 1,097 central stations in Canada and 114 pulp and paper establishments. The number of works producing electrical apparatus and supplies was 130; the capital invested in these totalled $80,476,000, and the gross value of their products was $78,558,730; they employed 16,813 people. The rapid expansion of Canadian industry is placing the Dominion as one of the leading industrial producers; 1929 is expected to set up a new record.

Before the war large sums of United Kingdom capital had been invested in Canada for the construction of railways, municipal improvements, water supply schemes and industrial and mining undertakings. A large number of United States firms had also established branch works in Canada. During the war the flow of United Kingdom capital to the Dominion almost ceased, and until recently comparatively small amounts have been invested. Since 1914 many other United States firms have established branch works in Canada, and the total is now put at between 600 and 700; they vary from small assembly works to large industries employing thousands. The Canadian Government estimated that at the beginning of 1927 the following amounts of foreign capital were invested in the country:—United States, $3,069,000,000; United Kingdom, $2,192,000,000; other countries, $238,000,000.

The Electrical Equipment Market.

The field for the sale of electrical equipment is large and expanding, and United Kingdom manufacturers have lately taken a definite interest in the market. There are difficulties, but the increasing appreciation of United Kingdom electrical equipment forms a good foundation on which to build business. Mr. Field says that it is not easy to make a positive statement regarding the ability of United Kingdom manufacturers to sell their products competitively, but, generally, they will find more difficulty in selling profitably the larger types of plant and equipment. There are certain classes of electrical machinery particularly suited to local conditions, the marketing of which is not such a perplexing problem. Given the proper sales organisation a fairly satisfactory profit might be expected over the complete range of manufactures.

A feature which militated against United Kingdom electrical manufacturers in Canada some years ago was general reluctance to conform to standard Canadian requirements. It was found that standards designed to meet conditions in Great Britain would not harmonise with the standards which had been set up by producers and users of Canadian electrical machinery. This situation is disappearing, due to the collaboration of United Kingdom manufacturers with their representatives and to the revised regulations of Government Departments and the various electricity supply companies, which are slowly becoming universal. The report states that the Canadian Electrical Code, Part I, was officially adopted in five Canadian provinces last year, and two others will probably do the same this year. The Code has also been adopted in the Bahamas. Committees are being formed to prepare Parts II and III, covering "Specifications" and "Outside" Wiring Rules." Other projects of the Canadian Engineering Standards Association, the body mainly responsible for the Code, are specifications for distribution transformers and transformer and switch oils.

Advice to Manufacturers.

In Mr. Field's opinion, many difficulties will be met by British electrical manufacturers in the Canadian market, but really enterprising agents will not find them insurmountable, provided they are backed by a willing organisation in Great Britain that will lend an ear to their troubles and deal with them seriously and sympathetically. A number of points are put forward for consideration. A manufacturer before developing his plans should visit the country to become acquainted with marketing conditions and to ascertain what competition he has to meet. He should assure himself that his products are suitable for Canadian conditions, or modify them to make them so. His shipping and stocking arrangements should be in line with those of his competitors, and he should be prepared to give better service than those competitors. There should be thorough co-operation between the headquarters of the company and the Canadian branch.

Mr. Field says that the United Kingdom Trade Commissioners in Canada have received the active co-operation of Canadians in their effort to secure a larger share of the import trade for Great Britain, and sentiment is strongly in favour of this development. One of the most important contributions to the furtherance of United Kingdom trade in Canada last year was the record number of British manufacturers and other business men who visited the Dominion to learn at first hand of its industrial growth and business prospects. Mention is made of the activities of the Canadian Trade Commissioner Service.

Preferential Tariff Qualification.

Goods which contained 25 per cent. of British labour and material have qualified in the past for the British preferential tariff rates. Early last year the Canadian Government announced its intention of reviewing the position, and on February 1st, 1929, a new regulation became operative providing that only goods which contain 50 per cent. of British labour and matrial will qualify for the preferential rates. The relevant clause of Invoice Form " M-B " now reads as follows :—" That each article on this invoice is *bona fide* the produce of manufacture of a country entitled in Canada to the benefits of the British preferential tariff and specified on the invoice as its country of origin, and that each manufactured article on the invoice in its present form ready for export to Canada has been finished by a substantial amount of labour in such country, and not less than one-half the cost of production of each such article has been produced through the industry of one or more British countries."

The effect of the new provisions in the case of certain classes of goods made in Great Britain from imported raw material is under discussion between the United Kingdom Government and the Government of Canada.

Hydro-Electric Development.

The development of water power has been one of the outstanding features of Canadian industry in recent years. The average for Canada has reached 554 h.p. per 1,000 of population. The Director of the Water Power and Reclamation Service has furnished figures which show that the initial operation last year of hydraulic turbines, aggregating 550,300 h.p., brought the total hydraulic development to 5,349,232 h.p. Other undertakings under construction will add over 1,200,000 h.p. to the total, and further developments are in prospect for the current year. The present recorded water power resources of the Dominion will permit of a turbine installation of approximately 43,000,000 h.p. A little less than 12½ per cent. of that total is developed. The Province of Quebec, for the fifth successive year, led in new equipment brought into operation during the year. An attempt has been made to trace the ultimate use to which the power is put. There are three main headings. The most important comprises central stations for general distribution for domestic, municipal, and commercial lighting and power purposes, and accounts for 83.1 per cent. of the total. The pulp and paper mills take 10.7 per cent., and, in addition, buy from the central power stations. General industrial uses, such as grist mills, machine shops, and electrical reduction plants and mining, account for 6.2 per cent. The highly industrial but non-coal producing provinces of Ontario and Quebec contain over 60 per cent. of Canada's known potential water power, while the change from agricultural to industrial predominance has led to the installation in these two provinces of over 80 per cent. of the country's total hydraulic development, representing an installation in Quebec of 902 h.p. and in Ontario of 590 h.p. per 1,000 of population. The total outstanding capital invested in water power development is about $1,172,600,000, and of this some $999,200,000, or 85 per cent., has been expended on land, buildings, plant and equipment for the generation, transmission and distribution of hydro-electric power. Applied to the existing installation this amounts to an average of $219 per horse power installed, including transmission and distribution. It is estimated that the total water power installation is capable of effecting a saving of about 32,095,000 tons of coal per annum. For the actual development, transmission and distribution of the new power capacity installed last year, together with that under construction, $330 million will be required. For every dollar so expended it is estimated that $6 is required to apply this power to its ultimate uses. On this basis a total expenditure of $2,300 million will result throughout the Dominion as a result of water power development.

Broadcasting.

There are about 90 broadcasting stations in Canada, and a Royal Commission is now studying the general question of broadcasting in the Dominion. According to the terms of reference of the Order-in-Council appointing the Commission, it is considered that the desired end might be achieved in several ways, provided funds are available, *viz.* : the establishment of one or more groups of stations operated by private enterprise in receipt of a subsidy from the Government; the establishment and operation of stations by a company, owned and financed by the Government; and the establishment and operation of stations by provincial governments.

" Metrovick " Power Plant Contracts.

Notes on recent orders from home and abroad for power plant, small self-contained sets, and electric mine winders possessing important features.

RECENT contracts placed with the Metropolitan-Vickers Electrical Co., Ltd., for turbo-alternator sets include an interesting variety of equipment, ranging from very large sets for interlinked main power stations down to sets of medium and small capacity for industrial power plant installations. The large sets include one of 50,000 kW for the Liverpool Corporation, one of 32,500 kW for the Victoria Falls and Transvaal Power Co., South Africa, and three 12,500-kW sets for the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board. The smaller sets are mainly of the self-contained type, which has attracted considerable favour on account of its compactness of arrangement, simplicity of operation, and high efficiency.

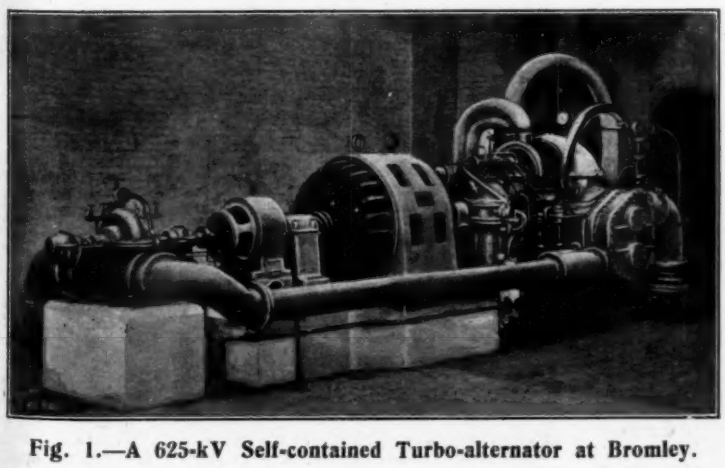


Fig. 1.—A 625-kV Self-contained Turbo-alternator at Bromley.

The 50,000-kW set for Liverpool, though not the largest the company has under construction, is one of the notable ones being built for stations in this country. It is to form the initial installation of the large new plant which is now being constructed at Clarence Dock. The first set is to consist of a 51,250-kW turbine driving at 1,500 r.p.m. a main alternator of 71,500 kVA, and a 1,562-kVA house-service alternator, both alternators to be excited by a double exciter also directly driven. The rated output of the set is to be 50,000 kW, measured at the h.p. terminals of the step-up transformers. The turbine is normally to operate with steam at 400 lb. pressure and 800 deg. F. total temperature, but it will also be capable of giving its full output with steam at 340 lb. pressure and 675 deg. F. The condenser is to be of the Metropolitan-Vickers central-flow type. The main alternator, which will generate at 7,250 volts, and the auxiliary generator will both be ventilated on the closed-circuit system, with an air-cooler capable of dealing with 120,000 cu. ft. of air per minute serving both machines. In addition to the equipment above mentioned, the contract placed with the company includes the step-up transformer equipment for the set, consisting of two 37,500-kVA, 7,250/33,000-volt, three-phase core-type units, together with auxiliary switchgear.

The 32,500-kW machine for the Victoria Falls and Transvaal Power Co. is for the extension of the Vereeniging station, which is one of a chain of large steam stations serving the mines and other industrial activities of the Rand in South Africa. The set is to run at 3,000 r.p.m. with steam at 200 lb. and 626 deg. F. The alternator will have a capacity of 40,000 kVA, generating at 10,500 volts, 50 cycles, and will have closed-circuit air-cooler equipment. The condenser will be of the central-flow type; the cooling water will be taken from the Vaal River, on the bank of which the power station is situated. The Vereeniging station is linked by an 80,000-volt line with the company's 132,000-volt Witbank transmission system, for which the transformers and switchgear were supplied by the Metropolitan-Vickers Co.

The three 12,500-kW sets for Stalybridge are required in con-

nection with the change of the system from 40 to 50 cycles, the Hartshead station, in which they are to be installed, being one of the selected stations for the national " grid " scheme. The sets are to operate at 3,000 r.p.m., generating at 6,300/6,600 volts. It is of interest to note that with the two 7,500-kW " Metrovick " turbo-alternators which the new equipment is to replace, this comparatively small station has achieved a remarkably high efficiency and remarkably low running cost. The latest published returns, for the year ended March, 1928, show a total cost, including management and all other expenses, amounting to only 0.43d. per kWh sold. The total power generated during the period mentioned was just over 40 million kWh, the load factor being 31.8 per cent.

The success of the M.-V. Co.'s development of small self-contained sets, of which a range of standard sizes from 200 to 4,000 kW capacity is manufactured, is indicated by the fact that within the short period which has elapsed since such rets were put on the market about 70 of them, totalling over 50,000 kW, have been supplied, or are now on order. A considerable number of them are for the British navy, some are for the navies of Chile and Japan, and the remainder for various industries in this country and abroad. The accompanying illustration (fig. 1) shows a typical installation at the works of the Gas Light & Coke Co., Ltd., at Bromley. The variety of their industrial applications is indicated by the most recent orders, which include two 2,000-kW sets for collieries in the Federated Malay States, a 1,000-kW set for a paper mill in China, a 1,000-kW set for a copper mine in Rhodesia, a 750-kW set and two of 280 kW, respectively, for an iron works and a jute factory in India, and a 2,800-kW set for an iron works in Belgium. The last-mentioned order is noteworthy in that the installation is for what may be called the " home continental area," in which the competition of continental manufacturers is very keen.

Five large electric winder sets are included among recent orders for mining equipment placed with the Metropolitan-Vickers Electrical Co., Ltd. All five sets are to be arranged for Ward-Leonard control, three with directly coupled motors and two with geared motors. They represent an interesting variety of applications, two being for a deep gold mine on the Rand in South Africa, two for a new copper mine in Northern Rhodesia, and one for service involving exceptionally heavy output at a colliery in New South Wales, Australia, where one of the largest electric winding equipments in the world is already in service.

New features of special interest are included in two of the equipments, those for Rhodesia, one development being a hydraulic slip regulator between the motor and the flywheel of the motor-generator set and the other an improved system of automatic braking control.

The two winders for the Rand are to be of 2,150 r.m.s. rating and 4,310 h.p. working-peak capacity, ordered by the Union Corporation, Ltd., for East Geduld Mines, Ltd., a subsidiary company which was registered and commenced operations two years ago. The electric winders are to replace two steam-engine equipments, one carrying men and the other hoisting ore, in an installation 5,600 ft. above sea level. The depth of the shaft is 3,350 ft. and the net load to be handled in the case of the ore hoist is 7 short tons (14,000 lb.), the output required being 230 tons per hour. The two equipments will be similar, the winder motor in each case having a normal speed of 58 r.p.m. and being coupled to two cylindrical drums 14 ft. in diameter and 5 ft. between flanges. The normal maximum winding speed will thus be 2,580 ft. per minute. The two motor-generator sets will each consist of an 1,800-h.p. 2,000-volt induction motor directly coupled to a 1,550-kW, 640-volt, d.c. generator. The sets will not be equipped with fly-

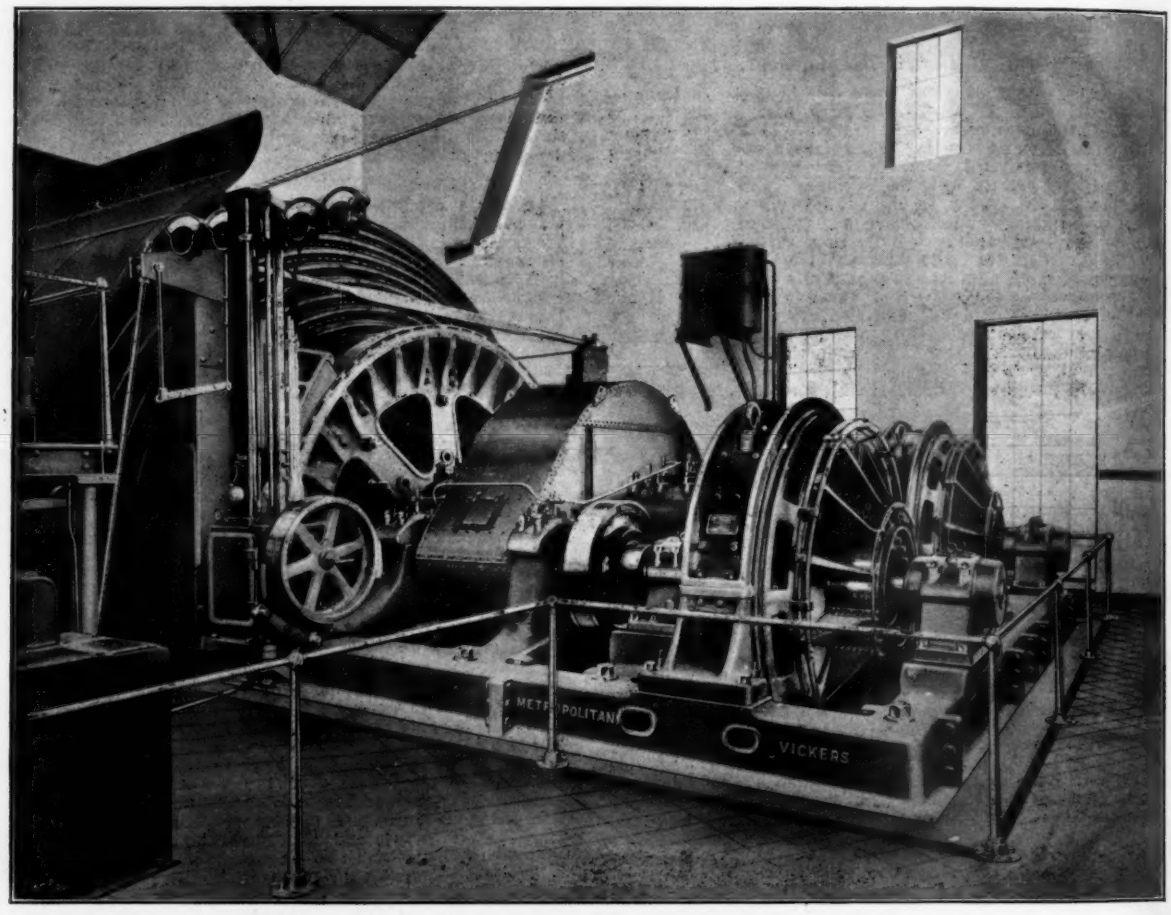


Fig. 2.—Electric Winder at Harworth Colliery, Yorkshire.

wheels, as the power will be taken from the large capacity distribution system of the Victoria Falls and Transvaal Power Co. It is intended ultimately to increase the working peak capacity of the equipments to 4,570 h.p. by taking out part of the permanent resistance in the generator field circuit, thereby increasing the winding speed by about 5 per cent. and the output capacity to 245 tons per hour. The Metropolitan-Vickers Co., Ltd., is the main contractor for the installation, including the cable work. The sub-contract for the mechanical parts has been placed with Messrs. Blane & Co., Ltd., of Johannesburg, who will supply parts manufactured by Messrs. Fullerton, Hodgart & Barclay, Ltd.

The Caledonian Collieries, Ltd.,* of New South Wales, have ordered, through their managing agents, Messrs. Howard Smith, Ltd., an electric winder of 1,900/4,000 h.p. to replace a steam engine equipment at a shaft of the Aberdare Colliery, where it is required to increase the output to 557 tons per hour. The new equipment is to do this by a schedule of 133 trips per hour with a net load of 4¼ tons. The time for the trip of 530 ft. will thus be only 27 seconds, of which 7 seconds will be allowed for decking. The acceleration will be 5.53 ft. per second, and the maximum winding speed 2,555 ft. per minute. The motor has been designed for operation at 70.5 r.p.m. and

* The company's new generating station was described in our July 5th, 1929, issue, p. 37.

will be directly coupled to a cylindrical drum 12 ft. in diameter and 6½ ft. wide. The motor-generator set will consist of a 680-h.p. induction motor coupled, with a flywheel, to a 1,170-kW d.c. generator, this equipment to be housed in a separate building about 50 yards from the winder house. The Metropolitan-Vickers Co., Ltd., is main contractor for the installation, including the cable work. The sub-contract for the mechanical parts has been placed with Messrs. Vickers-Armstrongs, Ltd.

It is interesting to note that at another shaft of the Aberdare Colliery there is installed one of the largest colliery winders in the world, a "Metrovick" equipment rated at 4,500/11,250 h.p. This winder raises a net load of 7½ tons from a depth of 1,260 ft., and maintains an output of 490 tons per hour.

The Roan Antelope Copper Mines, Ltd., which is operating in the opening up of a large new field of copper-mining concessions in Northern Rhodesia, has ordered two geared d.c. winders of 1,290/2,580 h.p. with Ward-Leonard control for a new shaft 1,100 ft. deep. In this installation also the two winders, one for men and one for ore, will be similar. The loads to be dealt with will be 12 short tons and 10 short tons, respectively, and the output of ore will be 500 tons per hour. The winding drums will be cylindrical and of 16½ ft. diameter in the case of the man hoist and of 14½ ft. diameter in the case of the ore hoist, with gear ratios to give the same winding speed of 1,400 ft. per minute in each case. Power will be supplied from the company's own system at 3,000 volts, three-phase, 50-cycles, and converted by a motor-generator set consisting of a 960-kW generator with a flywheel of 6½ tons.

A novel feature of these two equipments will be the use of a new type of slip regulator, consisting of a hydraulic coupling between the motor and the flywheel of the motor-generator set. The device is a development of the well-known Vulcan coupling which has been extensively employed for marine propulsion and industrial drives. It consists essentially of two main elements: an impeller wheel mounted on the motor shaft and a runner wheel mounted on the flywheel shaft, with a casing in which a controlled supply of oil provides the working medium. The oil circulates under pressure and by varying the amount admitted to the coupling the slip can be regulated to any desired value from practically zero to 100 per cent. The system is introduced as an important improvement upon the usual form of slip regulation by means of resistance in the secondary circuit of the driving motor of the flywheel set.

Another notable feature to be incorporated in the equipments for Rhodesia is a new system of braking recently developed and patented by the Metropolitan-Vickers Co. In this system the braking effort is applied as a function of the speed change of the cages, compensation being made automatically for all variations of load, speed of travel, and other conditions. The use of the new principle gives the equipment remarkable and highly desirable characteristics in that any given position of the brake lever will give a definite rate of retardation under all conditions, and any desired rate of retardation can be obtained without shock. The retardation under emergency conditions is also capable of accurate setting, a definite rapid rate of retardation being set for operation if the cages are approaching the end of their travel and a relatively low rate of retardation selected for operation if the cages are in an intermediate position. The system thus ensures any required stoppage in a reasonably short distance of travel, while eliminating the risk of sudden stoppages, which are a cause of grave danger to passengers and plant.

Tests made in the makers' works on experimental braking apparatus of this type have been remarkably successful, and arrangements are at present being made for tests in actual service on a large winder in service at the Harworth Colliery of Messrs. Barber, Walker & Co., Ltd. This installation, which is illustrated in fig. 2, is of the same type and of about the same capacity as those for the Roan Antelope Copper Mines and is itself of interest as one of the largest electric winders in this country. The results of the tests at Great Harworth and the performance of the two winders for Rhodesia, in which both the new features will be incorporated, will be watched with considerable interest, since the developments promise to have a far reaching influence on future winder practice.

Selected Radio-telephone Apparatus.

Recent Developments and Improvements.

In contradistinction to mass production, which is to so great an extent the order of the present day, there are several workers on a small scale who produce apparatus of real merit and novelty, and who are by the nature of their business able to give personal attention to any installation, however small, or contracts which may be entrusted to them. Especially in the case of wireless installations and the electrical "gadgets" connecting the receiver and the domestic electricity supply mains is there a demand for apparatus made to specification, to connect given mains to a given receiver, for instance.

Baty Products.

We have had brought to our notice two simple contrivances made by Ernest J. Baty, of Luton. One of them is a trickle charger for low-voltage batteries for use by those who are not fortunate enough to have electric light in their houses. By the use of a miniature water motor and dynamo (fig. 1), 0.3 amp. at 2.6 volts may be obtained from the water supply main at an expenditure of 48 gallons per hour. It is well known that attempts to charge batteries in this way have hitherto failed, except in a few cases in which, either due to high water pressure or large pipes, conditions have been exceptionally favourable. The efficiency of the combination under discussion arises from the use of a dynamo of very light construction with permanent magnets of special steel, so that no energy is wasted in magnetising the field, and the use of a two-pole dynamo combined with a Westinghouse rectifier to prevent the discharge which would take place during two quarters of each revolution. Although so small an output as 0.3 amps. at 2.6 volts seems ridiculous, it may nevertheless be a godsend to those who are not so fortunately situated. A more complicated contrivance is a combined anode energiser and filament battery trickle charger for operating a wireless receiver off a.c. mains. It works on a novel principle on the high-voltage side, although the trickle charger follows the usual lines. On the high-voltage side (fig. 2) there is no transformer and no choke, smoothing being accomplished by the use of

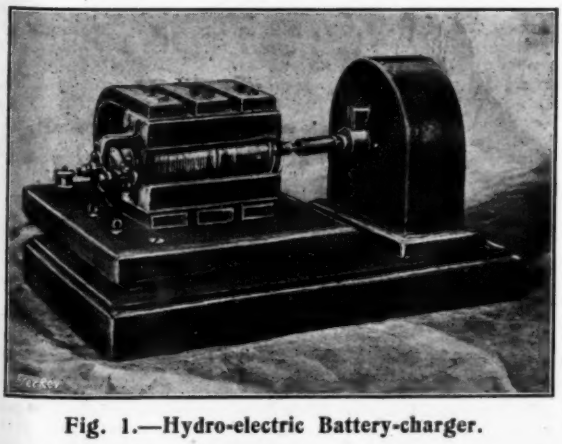


Fig. 1.—Hydro-electric Battery-charger.

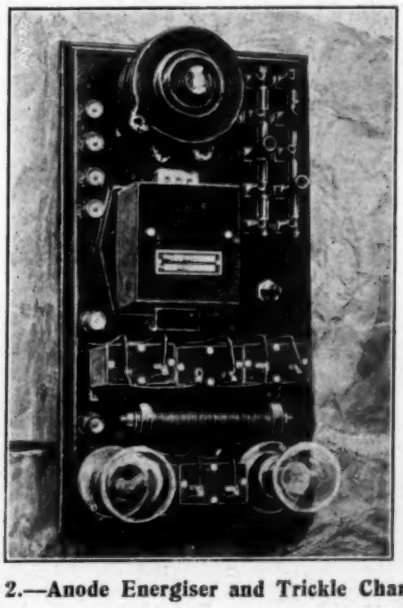


Fig. 2.—Anode Energiser and Trickle Charger.

two Westinghouse rectifiers; the consumption from the mains is only that taken by the receiver, *i.e.*, ten milliamperes or so. Either main is brought in through a lamp of 5 watts only; any part of the unit can be "shorted" without any perceptible heating, even after long periods. There are no deteriorating parts or valves. On the standard panel there are two h.t. supplies, both infinitely variable, and the trickle charger can be used for 2, 4 or 6 volts. The receiver is controlled from the panel, an ingenious switch cutting off the low and high voltages from the receiver in one position, with two other positions for trickle charging and receiver working, respectively. The outfit is unconventional in that it is not usually boxed, being assembled on a highly finished mahogany panel, 7 in. by 13 in., with an overall height of 5 in.; it is made to fit in a space usually occupied by the anode batteries. Either the high-voltage unit or the trickle charge may be obtained separately, but the maker prefers to install the devices himself, as when so doing he can adjust the voltage and current to those valves most suitable for the actual receivers to which the units are to be fitted.

The "Gecophone" Portable Set.

The General Electric Co., Ltd., informs us that it has improved its portable screen-grid 4-valve receiver, and also reduced the price of it. The improvements are not concerned with the circuit, or with the components, but relate to the case, which is now constructed in a more robust form than formerly and has a superior finish. The locks and fasteners are of new design, and an addition is a turntable to facilitate the rotation of the set during reception, so that the enclosed aerial can be inclined at the angle of greatest signal strength to the sought-for station. This useful device, a light metal one having a ball-bearing movement, is clamped for carrying purposes on the battery lid by a single screw, but it can easily be released when required. By the way, the "Gecophone" adjustable reed-cone movement is now fitted with an anchoring attachment, at no extra cost, which simplifies the attachment of the cone diaphragm to the armature reed.

New Marconiphone Products.

A new portable receiver at a popular price recently announced by the Marconiphone Co., Ltd., embodies the main features of Model 53, the winner of the 1928 Olympia show ballot for 5-valve sets. Although the new Model 55 is ten guineas cheaper, it is capable of approximately the same range performance. A new and improved form of cone loud-speaker is fitted, and a single three-position switch controls the valve filaments and wave-length ranges. Tuning is by edge control dials with white scales on which stations may be recorded. The cabinet is made of oak, and a turntable is fitted as standard. Five Marconi valves in a straight circuit are used, the battery equipment consisting of a 108-volt anode battery, 9-volt grid battery, and 2-volt 28-amp.-hr. unspillable filament accumulator.

The introduction of the first three valves of the Marconi "Point 8" series (H.8, HL.8, and P.8) created considerable interest a year ago. These valves are designed to operate entirely from a.c. mains, the filaments consuming 0.8 amp. at 0.8 volt and being supplied directly from the seconding winding of a suitable transformer.

Now come two additions to complete the list. The S.8 is a screen-grid valve with the special a.c. filament. It has an amplification factor of 160, and in a suitable circuit will give great magnification. A feature of the low-voltage filament is that no modulation is superimposed on the high-frequency impulses passing through the h.f. circuits. The most critical stage in the receiver is the detector, and previous attempts to provide a satisfactory directly-heated valve for this position have not met with success. In the D.8, however, an entirely new form of construction is adopted, and by using a massive low-voltage filament consuming 1.6 amperes an attempt has been made to obtain freedom from hum and background noises. The D.8 has a magnification factor of 14, impedance 21,000 ohms, and will take up to 150 volts on the anode. With these new valves almost any circuit may be converted to a.c. operation, and a special Marconiphone transformer is listed for the purpose. It has a tapped winding for the mains, and secondary windings giving 150+150 volts h.t., 5.5 volts for a U.5 valve, 0.8 volt, and finally 4 volts for one directly-heated valve, or a four-volt super-power valve in the last stage. We have also received samples of new Marconi 4- and 6-volt screen-grid valves, types S.410 and S.610.

Loud-speaker Testing.

Thousands of loud-speakers are manufactured every year, yet those who see the finished product hardly give a thought to the numerous tests which are applied to some of the better-known makes before they finally reach customers. In the factories of Messrs. Philips Lamps, Ltd., testing is carried out to an extent that has hitherto seldom been attempted. Speakers of all types, sizes, and shapes arrive in the testing room on a moving band, which conveys them direct from the assembly benches. Long before the testing room is reached examiners have rejected everything which has failed to pass their scrutiny. Those which are left are carried forward to a sound-proof room, where for a short distance each speaker makes contact with rods wired to the output of a small amplifier. It is fascinating to watch this parade of the loud-speakers and to listen as one after another picks up the tune for a short time, until the band carries it out of circuit. All the time specially-trained observers listen for deviation from normal rendering, and now and again the parade will halt while a suspect is compared with a master loud-speaker, which can be switched into circuit as is necessary.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this section.

A Machine-Tool Testing Outfit.

In order to keep pace with the increasing demand for their direct motor-driven machine tools, Messrs. Alfred Herbert, Ltd., Coventry, have installed an a.c. testing set in their testing department. This set, fig. 1, enables tests to be taken on a

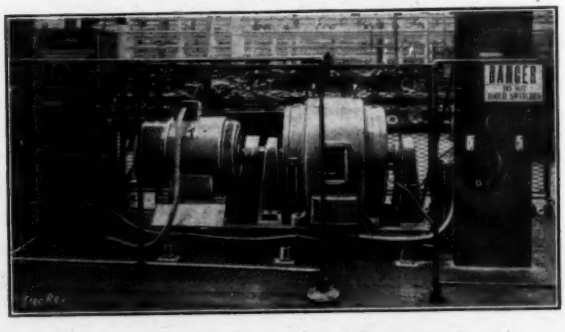


Fig. 1.—Testing Set for Motor-driven Tools.

customer's machine under working conditions, driven by its own motor, and using its own switchgear. The set is of the motor-driven alternator type, and by means of its control gear can supply power over the wide ranges of voltage, periodicity and phases met with in this country and abroad. It is intended shortly to extend the set to cover the more simple problem of direct current, in which case it will only be necessary to cater for varying voltages. It is thus possible to ensure accurate alignment of motor and machine, so essential for satisfactory chain driving, and to detect at the outset any faults in the motors and switchgear, subsequent failure of which invariably reflects on the machine tool-maker.

A New Fuse.

A new bomb-type fuse introduced by Messrs. Johnson and Phillips, Ltd., Charlton, S.E.7, utilises the explosive gases generated in an arc to extinguish that arc by their explosive force. The action of the fuse, when blowing, is that an explosion takes place within the explosion chamber, and the gases shoot along the bakelite tube and out through the mouth. Oscillograph records taken on a large number of tests show that this pattern of fuse clears the circuit in less than one cycle, and therefore in most cases the fault is cleared before it has developed to its worst degree. The robust construction, the quick action, and the definite air gap between live points when the fuse has blown give this design a very high rupturing capacity. Direct tests to earth taken recently on a supply authority's mains gave a calculated initial "short-circuit" current of 2,000 amperes (11 kV) and the fuses cleared the circuit satisfactorily and without damage to themselves. The construction of the fuse is very simple; it consists of a heavy brass explosion chamber attached to a length of stout bakelite tube, and the inside of

the tube is thickly lined with special porcelain cement. The bomb unit is supported on a metal carrier, which is fitted to a standard J. & P. pin-type supporting insulator. The bomb fuse unit is easily removed for re-wiring, fig. 2. To ensure good electrical contact between the fuse unit and the supporting bracket to which the line is attached, a spring contact of the finger pattern is provided in addition to the metal clamp grip which surrounds and makes contact with the explosion chamber. Not the least advantage of this fuse is

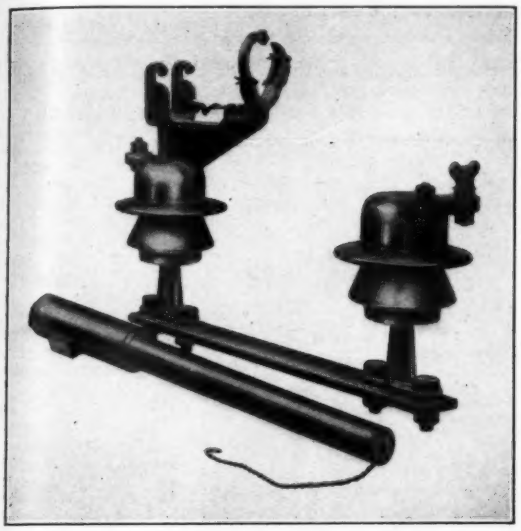


Fig. 2.—J. & P. Bomb-type Fuse and Carrier.

that ordinary lead fuse wire is used, and therefore re-wiring costs are reduced to a minimum. It is made in various patterns and voltages up to 33 kV.

A Moulded Connector Box.

We have received from MESSRS. WARD & GOLDSTONE, LTD., Frederick Road, Pendleton, Manchester, a sample of a very neat connector-box which they have produced. This device, which bears the company's trade-name, "Goltone," is illustrated in fig. 3. It is of circular shape, and consists of a base and lid. In the centre of the base there is an internally-threaded socket into which a central boss on the lid screws, effectively closing the box. The base has four lugs, into which are moulded four simple brass connectors provided with clamp-

Fig. 3.—The "Goltone" Connector Box.

ing screws. There are four "ways," equidistant between the lugs, and these are closed in by small flexible fibre fillets, which are securely held in grooves. Two fixing holes are provided. The box should be a useful accessory on systems employing c.t.s cables.

Special Plug Boxes.

The accompanying illustrations, figs 4 & 5, show one of several plug boxes for 500 V d.c. which have been supplied to the Port of Beira by Messrs. JOHNSON & PHILLIPS, LTD., Charlton, S.E.7, to control cranes belonging to the Harbour Board. The boxes had to be specially designed for installation in a very confined space and exposed position, water-tightness being the most essential feature. The complete box is buried in the concrete deck, the covers being flush with the deck to obviate obstruction to traffic, &c. All joints in the cast-iron body are machined, and special oil-proof and waterproof packing is also used to maintain watertightness. The mains are drawn into iron ducts, approximately 18 in. below ground, and consist of two single-core 0.4-sq. in. paper-insulated, lead-covered, and waterproof-served cables. The box is split along the cable

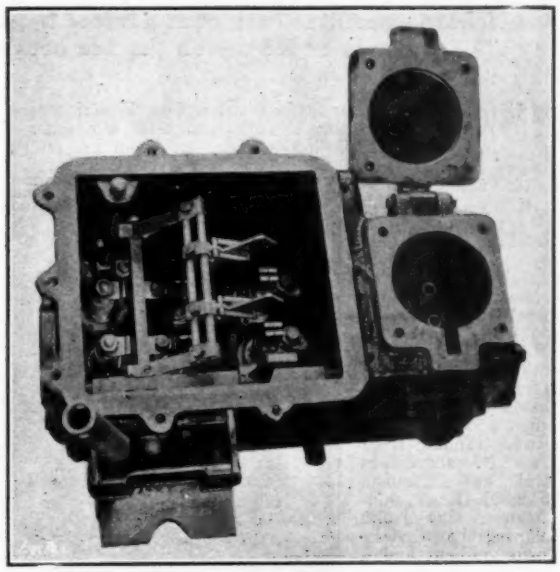


Fig. 4.—J. & P. Special Waterproof Plug Box, "Open."

centre line to facilitate jointing, and mechanical-type connectors serve to tap off the rubber leads to the fittings, which pass through porcelain insulators to a flexible link connected to the switch terminals. The lower portion of the box is compound filled. The switches for feeding the cranes are of 120-A capacity, and are of the quick double-break type, so as to dispose of any fear of an arc being maintained to the case. The switches are externally operated, the operating spindle passing through a stuffing gland into the body of the box. The switch contacts are mounted on porcelain insulators, and the switch blades are carried on insulated steel rods. The whole box is interlocked by the operating handle, it being impossible to remove the plug and the cover of the switch box when the switch is in circuit, and when either of the above are removed it is impossible to operate the switch. The latter safeguard may be an awkward feature in the event of the switch, &c., requiring repairs or overhauling; it has therefore been made possible for this interlock to be put out of action, when necessary, by skilled hands. The plug body is made in gunmetal, and the insulated base carries three pins, *viz.*, two

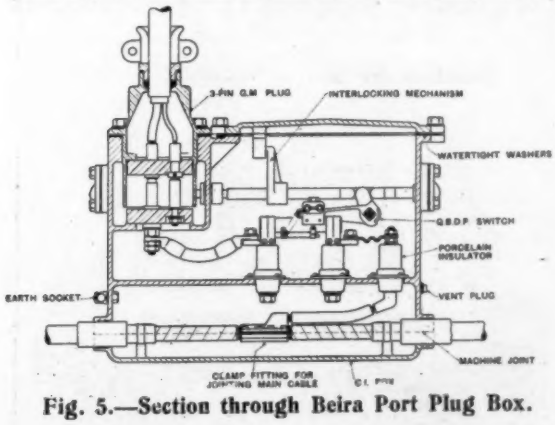


Fig. 5.—Section through Beira Port Plug Box.

circuit pins and one earth pin, which latter makes contact before and breaks contact after the circuit pins. A split bell-mouthed type stuffing gland is supplied to maintain water-tightness and also to grip the flexible tough rubber-sheathed trailing cable. A cover hinged to the body of the box covers the aperture for the plug when the latter is removed. Owing to the possibility of condensation, due to the varying temperature in the airtight box, a drain is provided to take away any moisture that may collect.

A Domestic Appliance Connector.

The makers of "A Domestic Appliance Connector" to which we referred in our issue of July 26th, p. 176, are Messrs. E. R. MORTON, LTD., 117, Charlotte Street, W.1.

Mountain Railway Service.

Electric locomotives have been adopted by the Sociedad Minera y Metallurgico de Penarroya for use on the line between Coquista and Puertollana.

THE Société Alsacienne de Constructions Electriques, of Belfort, France, has recently completed a number of interesting electric locomotives, fig. 1, for use on the railway between Conquista and Puertollana, Spain, of the Sociedad Minera y Metallurgico de Penarroya. The line, which is mainly intended to connect the various metal mines of the company, is also used for passenger traffic. Although only about 34 miles in length, it passes through very difficult country, the altitude ranging from 1,965 ft. above sea level at Conquista to 2,966 ft. at mid-distance, this being followed by a steep down gradient and a further ascent and descent to a level of 2,341 ft. at the end of the line at Puertollano.

Thus out of the 34 miles only seven miles are on the level, the up gradients ranging from 4 to 35 per cent. and the descents from 11 to 35 per cent. After full consideration of the conditions and the weight of the trains to be hauled, electric locomotives weighing 60 tons, fitted with six axles and using 3,000 V d.c., were decided upon. The axles are arranged in two bogies of three, fig. 2, and as the loads on the axles are not equal, the axles are connected together by coupling rods to increase the wheel adherence and consequently obviate wheel slip, which is injurious to the motors. The arrangement enables each axle to be provided with a separate motor, the three motors of each bogie being, however, always connected in series. The two groups of three motors can be connected in series or in series-parallel for starting or shunting purposes. Other advantages of the arrangement adopted are: (1) rheostatic braking is obtained in a simple manner; (2) the individual motors work at a relatively low pressure, consequently reducing any risk of overheating; and (3) the whole of the details of the engines are simplified.

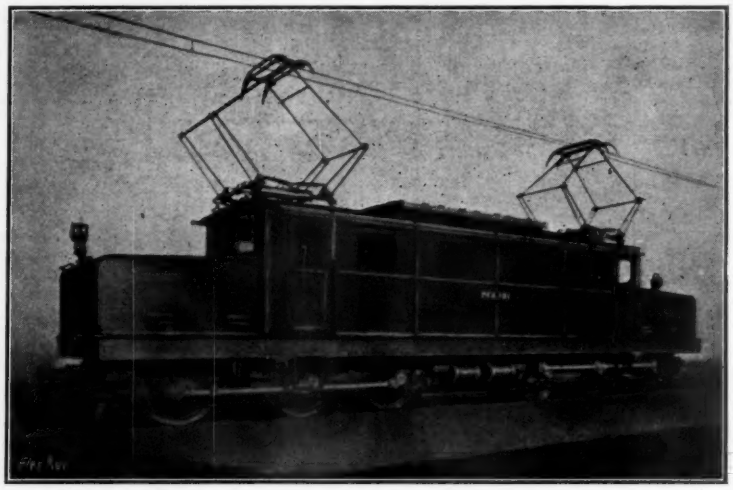


Fig. 1.—Spanish Mining Co.'s Electric Locomotive.

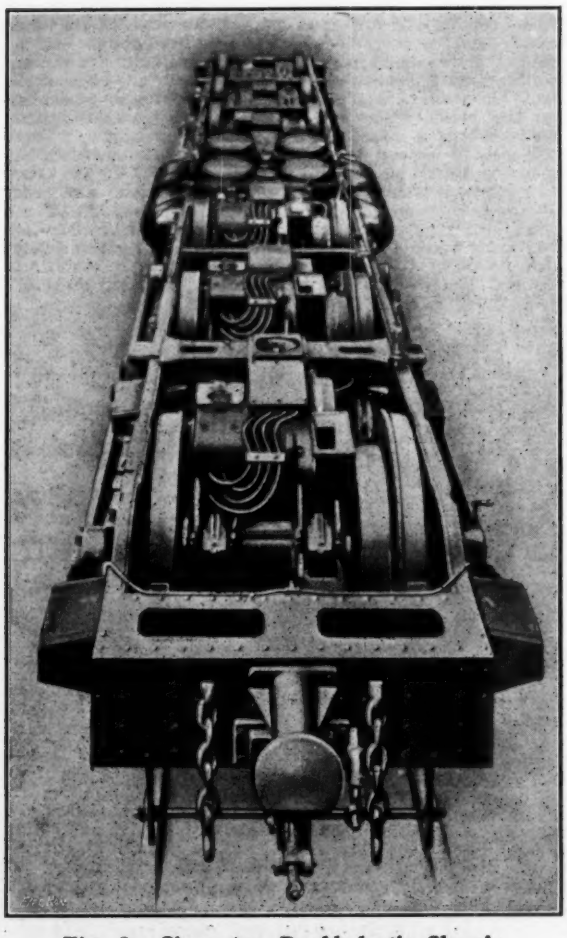


Fig. 2.—Six-motor, Double-bogie Chassis.

The engines have a wheel base of 37 ft. 4 in. and an overall length between buffers of 48 ft. 9 in., the height to the top of the current collectors being 12 ft. 1 in. The axles are not set at equal intervals, the centres between the first and second and the fifth and sixth axles being 6 ft. 8¼ in., and between the second and third and the fourth and fifth axles 5 ft. 9 in. The motors, which are provided with forced ventilation, drive the axles through steel gear wheels with a ratio of 1 : 4.88. Although the line has only a gauge of one metre, by mount-

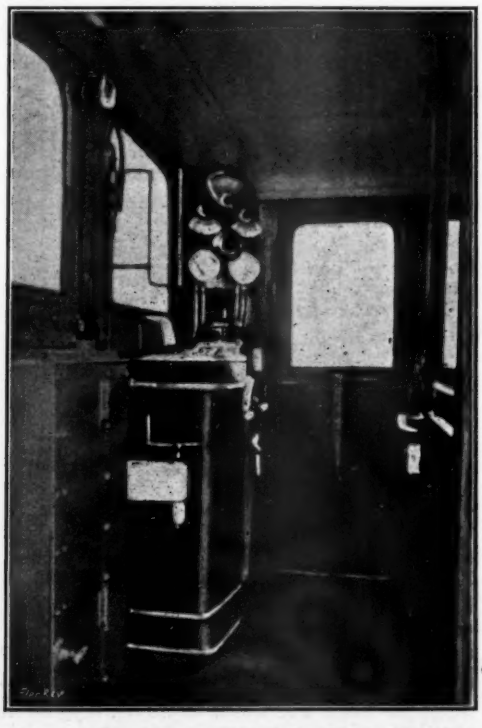


Fig. 3.—Interior of one of the Driver's Cabs.

ing the wheels within the frame it has been possible to provide the engine with steel bodies 8 ft. 7 in. in width. The machines are fitted with duplicate control gear, so that they can be driven from either end, a passage along one side connecting the two drivers' cabs, fig. 3. In addition to the rheostatic brakes already mentioned, vacuum and hand-controlled brakes, as well as rail-sanding apparatus, are also provided. The rheostats, which are kept cool by means of electrically-driven fans, are mounted under bonnets at the front and rear of the engine. The fact that the line passes through a mining district in which the atmosphere is heavily laden with dust rendered it necessary to enclose all the working components, provision being also made for filtering the air entering the motors and the h.p. apparatus cabin. Moreover, in order to ensure regularity of operation, the motors and h.p. apparatus were all submitted to severe tests, 15,000 V for 15 seconds and 11,000 V for two minutes, before being installed in the chassis.

Electricity in Holland.*

The Growth of Public Supplies in Recent Years.

ELECTRICITY supply in Holland has shown a steady and healthy development without undue governmental interference. Statistics show that the mean increase in kWh produced in the eleven provinces of the country amounted to some 146 per cent. between 1920 and 1927, whilst for the last available year (1926 to 1927) the mean increase was 14.6 per cent.—the latter figure being almost uniform for the various districts. The average consumption per inhabitant throughout the country was 145 kWh in 1927.

Considering that Holland is not a prominent industrial country and that, in the absence of water power, all electricity has to be produced from coal, these figures are eminently satisfactory. The three chief reasons for this may perhaps be stated as:—

(1) Advantageous conditions for coal and water supply and the many suitable sites for electricity supply stations available.

(2) Unhindered development under sound technical and economical conditions of supply companies, both in the towns and in the country, and their unforced combination whenever found desirable.

(3) An energetic determination on the part of almost all the electricity supply authorities to seek out new applications for electricity and to devise attractive tariffs suitable for each class of work.

Table 1 shows the way in which the prices of energy in the city of Amsterdam for various uses have all fallen steadily during the last few years.

A consideration of a map of Holland shows that, on the whole, the various provinces each supply their own electricity requirements. This arrangement has developed naturally from the original town supplies. The Government has, of course, taken a certain interest in the matter and no less than four State Commissions have been set up to deal with the electricity supply question, but, in the end, State interference has practically been allowed to lapse.

It is true that most of the supply companies work under State concessions, but they have been freely accepted, do not rest on any statutory basis and are, consequently, of problematical importance.

The general tendency has all along been towards a step-by-step concentration. First, the various smaller town stations were driven into combination amongst themselves, and later these became merged into the general supply system of the province. The next step would seem to be the linking up of the provincial central stations with one another by means of 50-kV overhead lines, such as the one now in process of construction between the provinces of Friesland and Groningen.

TABLE 1.

Use.	1924 Consumption (1000 kWh).	1924 Average price per kWh pence.	1925 Consumption (1000 kWh).	1925 Average price per kWh pence.	1926 Consumption (1000 kWh).	1926 Average price per kWh pence.	1927 Consumption (1000 kWh).	1927 Average price per kWh pence.	1928 Consumption (1000 kWh).	1928 Average price per kWh pence.
Power	58,148	1.08	58,165	.96	58,725	.94	61,582	.84	68,274	.84
Large household consumers ...	6,255	2.95	7,136	2.65	8,000	2.4	9,454	2.1	11,201	1.85
Small household consumers ...	53,857	3.9	61,795	3.5	70,910	3.2	82,216	2.9	89,377	2.6
Public lighting	4,611	1.2	5,251	1 2	5,971	1.2	7,404	.9	7,704	.9
Tramways ...	14,441	.94	14,304	.94	15,722	.75	16,618	.75	18,748	.63
Total† ...	144,692	2.15	155,125	2.05	1f8,504	1.95	188,364	1.8	2 0,722	1.6

Fig. 1 shows this tendency clearly. Curve 1 shows the number of small power stations (under 100,000 kWh a year), curve 2 gives the number of the larger stations (over 100,000 kWh a year), whilst curve 3 shows the rapid rise in annual output per station for the larger stations (over 100,000 kWh per year).

The distribution of electricity has also become very general, without intrusive governmental regulation. Thus in 1919, of the 1,118 communities with their 6.449 million inhabitants, 495 communities with 5.3 million inhabitants, or

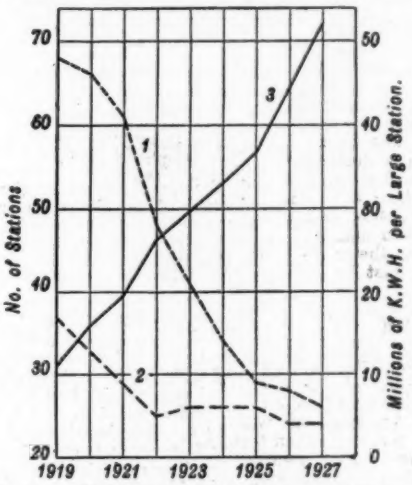


Fig. 1.—Number and Outputs of Stations.

80 per cent., came within the range of electricity supply. In later years this proportion has steadily increased, and in 1927 of the 1,070 communities with 7.625 million inhabitants, 919 communities with 7.360 million inhabitants, or 96.5 per cent., were within reach of electricity supplies.

Since 1927 the railway companies have also begun the electrification of the heavy traffic sections of their lines. Direct current at 1,500 V was selected for this purpose, and it was obtained from the existing central stations in the form of a 3-phase supply and converted by means of mercury rectifiers. The demand for this purpose was 25 million kWh in 1927 and 45 million kWh in 1928. It was a wise decision of the Ministry of Communications at the time which prevented the railway authorities from erecting their own separate supply stations and encouraged them to take their supplies from the existing large power stations, as this has undoubtedly aided the latter greatly in their expansion and interconnection.

The article concludes with some interesting details as to the steady advance of electricity supply in Amsterdam, where, thanks to the free wiring scheme in use, practically every one of the 187,779 houses is now connected to the mains, whilst all the public lighting is done by electricity and the use of electricity for heating, cooking and the household hot-water supply is becoming more and more popular.

* Abstract of an article by Dr. W. Lulofs in "E.T.Z." for June 13th, 1929.

† Including energy supplied in bulk to the Zaundum district.

Reviews.

Radio Receiving Tubes. By J. A. MOYER and J. F. WOSTREL. Pp. vii+297; figs. 180. London: McGraw-Hill Publishing Co., Ltd. Price 12s. 6d. net.

Anyone setting out to write a book on wireless has to decide at the outset what range of the subject is to be dealt with and what type of readers are to be catered for. Unfortunately these questions are not always sufficiently considered beforehand, with results that are generally serious. The book now under review is a case in point. Nominally the authors are writing of receiving valves. Actually the book attempts to deal, not only with valves, but also with the general theory of electricity, combinations of valves and circuits and even of certain applications of high-frequency currents in which the valve plays only on indirect part. Some parts are obviously intended for readers having no knowledge of technical electricity, but others assume a fairly intimate experience of high-frequency phenomena. Moreover, a great deal of the book is unattractively written, repetitions are frequent, side issues are repeatedly allowed to intrude on main lines of argument, statements of fact frequently masquerade as explanations

of physical phenomena, and all the technicalities are American. Thus, although much of the information is unquestionably sound, the book is hardly one that can be recommended to readers in this country.

Turning to the actual contents, Chapters II and IV deal fairly well with the construction and action of the three-electrode valve. The four-electrode valve is included, but the treatment is inadequate. Chapter III, on electrical theory, should be omitted, as it is merely a *résumé* of the theory to be found in all the ordinary text books. In the middle of the book there are notes on methods of re-activating thoriated filaments—which also might well be deleted nowadays—followed by fairly full accounts of the use of valves for detecting, amplifying and generating alternating currents. A lengthy account of a works testing equipment and a number of details of American valves are also included. The book ends with a description of some uses of valves in industrial processes, telephone repeaters, aeroplane control and electrical prospecting. The tables in the appendix have little connection with the main subject of the book.

The printing and reproduction of the diagrams are of the well-known standard of the publishers, but there are many mistakes, the main responsibility for which, it is to be feared, must be taken by the authors.

Estimating. By T. H. Hargrave. Pp. viii+120; figs. 140. London: Sir Isaac Pitman & Sons, Ltd. Price 7s. 6d. net.

Sir Isaac Pitman & Sons, Ltd., are to be congratulated upon the addition of one more valuable book to their already extensive library of technical and commercial text books. Two or three years ago the writer endeavoured to find just such a book as this one, when setting up an estimating and planning department in an engineering factory, and, after long search, he had to be content with a handbook which gave some of the basic information contained in Mr. Hargrave's volume, but without that explanation leading up to the tables, which is so essential for the student in search of knowledge, or for one who is called on to take charge of this side of the administration of a factory.

In fact, the only real fault we can find with the present volume is its price. It is specifically intended for the young engineer, but, whereas the manager or head of the business, whom the author hopes will be interested in it, would not be frightened by the price, our young engineer has to be quite sure of the value of his purchase before he is willing to risk even so much as 7s. 6d. on a single textbook. The book is so good that every young engineer ought to have a copy, and so should several men who are not engineers; it is a pity that the publishers and the author could not have seen their way to issue the volume at a price more within the reach of the younger man. Nevertheless, we think that even for the most impecunious it would be 7s. 6d. well invested.

After defining the scope of estimating, the qualifications necessary for the estimator, the other duties that fall to his lot, and the main divisions of estimating, the author proceeds either to give samples of the basic information upon which estimates are based, or to tell where they can be obtained, and in doing so he demonstrates the fact that this is not merely an office job. The man who wants to be an estimator must know, first and foremost, the shop, the materials used, their qualities and properties, the machine tools and their capabilities, and, above all, the men responsible for the transformation of raw material into finished products. Some day, perchance, manufacturers will begin to realise that, to a large extent, their turnover is in the hands of their estimators. A mistake in estimating, or in the method of estimating, is too often the cause of the loss of an order, or of the profit on the order. When the manufacturer understands this, he will appreciate the need for a thoroughly capable man to make up his estimates, and the thoroughly capable men will be those who prepare themselves both in the shop and the office for this work.

Mr. Hargrave has condensed so much into his 120 pages that it is almost discourteous to complain of omissions, but we do feel that he has not made quite enough of the effect upon estimates and costs of the use of machine rates. He thoroughly approves of their use, and who, having studied the subject, does not? But if he had introduced them into the examples, instead of merely saying that such and such a result might be quite different if the establishment charges were included, the estimator-to-be would have been warned of a trap set for unwary feet.

Then again, the fact that an estimate can be much more than the basis for a sale does not appear to be sufficiently stressed. The author warns the reader that estimates should be based upon what the shop can do, and not what it might do, whereas we are convinced that, in the majority of shops in the country, it would be much better to estimate on what should be done, and then make sure that the performance, and hence the cost, is kept within the limits of the economical production so prescribed.

Mr. Hargrave is the instructor in works organisation and costs at Horwich Technical College, but it is quite obvious that, before he entered upon his academic profession, he must have gained much experience in workshops. He dedicates his manual to engineering students, draughtsmen, cost clerks, foremen and works managers. To all who come within these categories, we have not the slightest hesitation in recommending his excellent introduction to the science and art of estimating.

Electrical Engineering Problems. Part II: Alternating-Current Circuits and Apparatus. By J. G. Pertsch. Pp. vii+105; figs. 48. London: McGraw-Hill Publishing Co., Ltd. Price 7s. net.

This is a collection of 432 problems dealing with a.c. circuits and machines, and is a companion to Part 1 on d.c. problems by the same author. It must be stated at once that there are no answers given to these problems, nor are there, except in a very few cases, any hints as to their solution. This fact naturally limits, very narrowly, the utility of such a book. So far as the student is concerned, a set of questions is very little use unless he can either get help in their solution or can consult the answers as a check on his working. Such questions chiefly have value when they are set in connection with a particular examination for which the student is aiming. So far as the professor or lecturer is concerned, although the questions may be usefully suggestive, a set of answers would have made them very much more helpful. Within these limits of usefulness the questions appear to be a very comprehensive and admirable selection, although some of the more advanced sections, such as that on power factor improvement, might have been fuller. The classification and arrangement is clear and good. Most of the problems are not specifically American in their applicability, the predominence of 60-cycle frequency being the biggest difference. As an outline or basis for a tutorial class in a.c. work the book should prove of value.

D. J. B.

Technologisches Handbuck der Elektrotechnik und der Elektrochemic: Eine Encyklopädie der Elektrotechnik. Edited by Alfred Schlomann. Pp. xviii+1491; illustrated. Berlin: Technische Wörterbrücher-Verlag G.M.B.H. Price 80 RM.

The original idea on which this book is based was that of a complete encyclopædia of the whole of technology on which Herr Schlomann started some twenty years ago. This, however, had to be abandoned later, owing to its enormous scope, and he then decided to confine himself to an encyclopædia of electrotechnology and its allied chemical branches, and this, with the aid of numerous collaborators and the active support of the Verband Deutscher Elektrotechniker and other scientific and technical societies, has now been brought to a successful conclusion.

Herr Schlomann is the editor of the well-known technical dictionary in six languages, and many of the definitions and illustrations collected for that work have been employed in the present book. It is divided into thirteen sections, each dealing with a particular branch of electrotechnics, so that a general outline of any of these branches can be readily obtained by reading straight through the corresponding section, the text continuing fairly smoothly from one key-word to the next, and being clearly illustrated at every stage.

The chief use of the book, however, will be for reference, and for this purpose a very complete "key-word" index, occupying 158 pages, is given at the commencement. A glance at this index will generally show the exact column in which any required subject is dealt with. Unfortunately, detailed references to the literature of the subject have had to be omitted for financial reasons, at any rate in this first edition, so that it is difficult to refer back to the original sources when desired.

Correspondence.

Correspondents should forward their communications **as early as possible.** *No letter can be published unless we have the writer's name and address in our possession.*

Reasonable Charges for Electricity.

With reference to your leaderette on Mr. L. L. Robinson's suggestion of a two-part tariff, I have for long been an advocate of a universal two-rate tariff, and I think it has many advantages, being applicable to all classes of supply. It is simple, easily understood, and fair to all types of consumer; really the only objection is the additional cost of metering, due to the necessity of having a double counter and a time switch.

I am afraid, however, the suggested limitation of the high rate to two hours is not sufficient. The attraction of the low rate available at an early hour in the evening would probably produce after the first and normal peak a second and still higher peak load.

The high rate should be in force in winter from sunset to 8 p.m. Theoretically, there should be a high-rate period in summer, but for revenue purposes it would probably be advisable to have a two-hours' period in those months.

The two-rate tariff would deal faithfully with those consumers whose demands really mean a loss to the undertaking; for instance, the consumers who use radiators for one or two hours only in the evening, and usually on the peak—at present a bugbear to most undertakings and likely to become a most serious problem when bulk supplies become more general.

M. Farrer.

Twickenham,
August 2nd, 1929.

Synchronous Motors.

After having consulted numerous text-books dealing with the synchronous motor, I find that none of their eminent authors attempt to give a physical explanation of the reason why these motors, when over-excited, take a leading current. They rely entirely on vector analysis, which, I think most people will agree, does not help one to visualise the effects that are taking place in the motor. I have never yet met any student, or qualified man, who has been able to offer any theory; most of them, in fact, never seem to have bothered about the matter at all, but have just taken it for granted.

I am hoping that some of your technical readers will take the matter up, not merely for my benefit, but for the sake of electrical students generally. A further suggestion is that some enterprising gentleman should publish a book dealing with these rather obscure problems.

Non-Mathematician.

July 29th, 1929.

Legal.

Valve Patent Action Abandoned.

WE have received from Messrs. Selfridge & Co., Ltd., a long statement in the course of which they state that Marconi's Wireless Telegraph Co., Ltd., has given notice of the discontinuance of an action which it instituted against Messrs. Selfridge two years ago. The matter arose out of the sale of "Cleartron" radio valves by Messrs. Selfridge, the Marconi Company alleging that those valves infringed patents of which it is the owner.

Holsworthy Gas and Electric Supply Co., Ltd.

THIS company has presented a petition to the Devonshire County Court, Barnstaple, praying for the confirmation of an alteration in its articles of association deleting such parts as relate to the making, selling, and supplying of gas. The petition is to be heard by Judge Lindley at the Guildhall, Barnstaple, on August 13th.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken

1928.

4,426. "Automatic electric switch mechanism." W. Rea. February 13th, 1928. (315,441.)

4,549. "Multiphase alternating-current rectifiers." S. G. S. Dicker (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). February 13th, 1928. (315,443.)

7,596. "Electric discharge tubes." International General Electric Co., Inc. March 16th, 1927. (287,138.)

7,713. "Electromagnetic indicating devices, relays, and the like." English Electric Co., Ltd., and G. Tilstone. March 13th, 1928. (315,447.)

7,983. "Circuit arrangement for transmitting signal messages over telephone lines." Siemens & Halske Akt. Ges. July 20th, 1927. (294,196.)

9,798. "Distribution of electric current." S. G. Double and B. J. Hall and Co., Ltd. March 31st, 1928. (315,234.)

10,004. "Electrical precipitation of suspended particles." Compagnie des Mines d'Ostricourt. April 4th, 1927. (288,208.)

10,085. "Electric signalling systems." Fabrique d'Appareils Electrique Favarger Soc. Anon. April 5th, 1927. (288,300.)

10,254. "Apparatus for rectifying alternating currents." S. A. Stevens and Westinghouse Brake & Saxby Signal Co., Ltd April 4th, 1928. (315,284.)

10,259. "Electricity meters." Chamberlain & Hookham, Ltd., and S. James. April 5th, 1928. (315,204.)

10,547. "Electric transmitters suitable for use in telegraphy." Creed and Co., Ltd., and R. D. Salmon. April 10th, 1928. (Addition to 291,854.) (315,244.)

10,550. "Electric furnaces." Wild-Barfield Electric Furnaces, Ltd., and L. W. Wild. April 10th, 1928. ((315,246.)

10,551. "Electric music instrument." E. Spielmann. April 10th, 1928. (315,286.)

10,553. "Devices for application to pipes for repairing bursts, earthing electrical apparatus, and for other purposes." W. Luxford. April 10th, 1928. (315,247.)

10,710. "Automatic and semi-automatic telephone systems." Siemens Bros. & Co., Ltd., and D. P. Long. April 11th, 1928. (315,291.)

10,792. "Control of electrical apparatus." General Electric Co., Ltd., and E. H. Croft. April 12th, 1928. (315,452.)

10,844. "Speed-controlling mechanism for electric motors." Dr. F. B. Dehn (Burroughs Adding Machine Co.). April 13th, 1928. (315,337.)

10,929. "Electric couplings." A. Reyrolle & Co., Ltd., and G. R. Wilson. April 13th, 1928. (315,457.)

10,976. "Electromagnetic reciprocating motors." Central Electric Tool Co. July 9th, 1927. (293,685.)

11,396. "Apparatus for the recovery of metals by electrolysis." F. Collingridge. April 18th, 1928. (315,481.)

11,447. "Automatic and semi-automatic telephone systems." Standard Telephones & Cables, Ltd., E. P. Goodwin, J. H. E. Baker, and A. H. Cameron. April 18th, 1928. (315,482.)

11,560. "Wireless receiving apparatus." T. A. Biddington and R. Field. April 19th, 1928. (315,487.)

11,593. "Method of electrically reproducing gramophone and like sound-records." P. D. Tyers. April 19th, 1928. (315,488.)

12,069. "Dirigible headlights for motor vehicles." F. Stafford and J. P. Hall. April 25th, 1928. (315,494.)

12,160. "Relays and other electromagnetic instruments and machines." R. E. H. Carpenter. April 25th, 1928. (315,496.)

12,322. "Electric fuses." Simplex Conduits, Ltd., and H. F. McLoughlin. April 27th, 1928. (315,499.)

12,368. "Diaphragms for acoustic instruments." R. W. Paul. January 24th, 1929. (315,501.)

12,421. "Clamping devices for electric conductors." J. W. Hofmann (trading as J. W. Hofmann, a firm). August 17th, 1927. (295,677.)

12,427. "Electric circuit breakers." Associated Electrical Industries, Ltd. April 30th, 1927. (Addition to 288,326.) (289,778.)

12,550. "Telephone systems, comprising automatic telephone exchanges of different systems." Telefonaktiebolaget L. M. Ericsson. April 30th, 1927. (289,782.)

13,429. "Electrical supply systems." Igranic Electric Co., Ltd., and J. H Abbink-Spaink. May 7th, 1928. (315,511.)

14,110. "Systems of electric distribution." British Thomson-Houston Co., Ltd. May 13th, 1927. (290,576.)

14,590. "Radio-telephone signalling." E. H. Armstrong. May 18th, 1927. (2.0,642.)

14,642. "Flicker-producing devices applicable to imitation solid-fuel fires." British Thomson-Houston Co., Ltd., and L. J. Davies. May 18th, 1928 (315,515.)

15,139. "Electric cable protection." G. L. Porter and Ferranti, Ltd. May 23rd, 1928. (315,521.)

15,932. "Fuse bases." Siemens-Schuckertwerke Akt. Ges. February 17th, 1928. (306,109.)

16,019. "Aerial conductors for use in radio communication." J. M. Ortega. June 1st, 1928. (315,532.)

16,097. "Buoys and similar floating bodies fitted with acoustical signalling means." J. Pintsch Akt. Ges. June 2nd, 1927. (291,457.)

16,922. "Concentric wall plugs for electric wiring." S. C. L. V. Larsen. July 30th, 1927. (294,873.)

17,857. "Diaphragms for electrolytic cells." K. Wolinski. June 20th, 1928. (315,551.)

18,174. "Electric accumulators." Chloride Electrical Storage Co., Ltd., and B. Heap. June 22nd, 1928. (315,556.)

19,159. "Röntgen tube having its anticathode movable relatively to the cathode." E. Pohl. July 2nd, 1927. (293,318.)

19,405. "Relays and like components of telephone apparatus." Sterling Telephone & Electric Co., Ltd., N. Blades, and J. R. Beard. July 4th, 1928. (315,563.)

19,497. "Electric immersion heaters, particularly for type-metal pots." British Thomson-Houston Co., Ltd. July 5th, 1927. (293,305.)

19,505. "Constant-frequency wave source." Electrical Research Products, Inc. October 18th, 1927. (298,975.)

20,340. "Selenium and like cells." H. J. Kuchenmeister. July 16th, 1927. (294,108.)

20,741. "Electric control systems." British Thomson-Houston Co., Ltd July 26th, 1927. (294,574.)

20,742. "Multi-core oil-filled high-tension electric cables." Soc. Italiana Pirelli and L. Emanueli. July 17th, 1928. (315,570.)

20,756. "Electric accumulators." H. Dean and Chloride Electrical Storage Co., Ltd. July 17th, 1928. (315,571.)

21,272. "Diaphragms for acoustic devices." British Thomson-Houston Co., Ltd., and L. B. Ault. July 23rd, 1928. (315,578.)

21,452. "Subaqueous sound apparatus." Electroacoustic Ges. December 8th, 1927. (Addition to 294,959.) (301,886.)

21,623. "Positive electrode for electrical accumulators, more particularly for use in miners' lamps." O. Schneider. June 14th, 1928. (313,553.)

21,839. "Electric switches." W. Geipel, Ltd., and K. S. Geipel. July 27th, 1928. (315,583.)

23,307. "Electric sound boxes or pick-ups for talking machines." E. Asch and Ideal Werke Akt. Ges. für Drahtlose Telephonie. August 13th, 1928 (315,596.)

23,543. "Electrodes for contact rectifiers." Siemens-Schuckertwerke Akt. Ges. January 27th, 1928. (304,748.)

23,614. "Photo-electric cell systems." General Electric Co., Ltd., and N. R. Campbell. August 16th, 1928. (315,598.)

25,041. "Electric wiring applicable to metal vehicle construction." A. E Short and H. O. Short. August 31st, 1928. (315,613.)

26,098. "Apparatus for transmitting railway signals to a moving train." Allgemeine Elektricitäts Ges. September 12th, 1927. (Addition to 283,165.) (297,038.)

26,412. "Trucks for tramway and railway rolling stock." Electro-Mechanical Brake Co., Ltd., and J. H. Williamson. September 14th, 1928. (315,621.)

26,739. "Telephone call bells." Telefonaktiebolaget L. M. Ericsson. September 20th, 1927. (297,389.)

26,893. "Supports for electric lamps." General Electric Co., Ltd., and E. L. Randall. September 19th, 1928. (315,623.)

29,433. "Motor-operated electric switch and valve apparatus." Fabrik Elektr. Apparate F. Sauter Akt. Ges. October 15th, 1927. (298,642.)

29,698. "Apparatus for generating mercury-vapour or other vapour having a low heat-conducting characteristic." British Thomson-Houston Co., Ltd. October 14th, 1927. (298,905.)

29,904. "Multiple-filament electric incandescent lamps." R. P. A. Anderson. October 16th, 1928. (315,638.)

30,517. "Systems for automatically paralleling alternating-current circuits." Associated Electrical Industries, Ltd. October 20th, 1927. (299,318.)

32,122. "Device for transmitting signals from the railway track to a moving train." Allgemeine Elektricitäts Ges. November 4th, 1927. (Addition to 283,165.) (299,895.)

34,457. "Gas-proof housing for electrical apparatus." Siemens-Schuckertwerke Akt Ges. December 8th, 1927. (301,902.)

1929.

1,810. "Systems of electric distribution." British Thomson-Houston Co., Ltd. January 19th, 1928. (304,324.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from July 31st.:—

Aeroto. No. 501,885. Class 6. Electric fans.—The British Aerotechnical Co., Ltd., Astor House, Aldwych, W.C.2.

Columbia Electro Gramophones (lettering and design). No. 501,807. Class 8. Electric talking machines and parts thereof.—The Columbia Graphophone Co., Ltd., 102-8, Clerkenwell Road, E.C.1.

Gothic. No. 502,551. All goods in Class 8.—Gothic Electrical Supplies, Ltd., 5-9, Severn Street, Birmingham.

The Voice of Action; Western Electric Sound System (lettering and design). No. 503,170. Class 8. Recording and reproducing apparatus for sound kinematograph films.—The Western Electric Co., Ltd., Bush House, Aldwych, W.C.2.

Philomonic, No. 503,617, and Gradionic, No. 503,618. Class 8. Wireless telephone apparatus in combination with gramophones, and parts thereof.—Kemble & Co., 97, Carysfort Road, Stoke Newington, N.16.

Meteor. No. 500,786. Class 13. Electric lamps (ordinary).—The Meteor Electric Lamp Co., Ltd., Sicilian House, Sicilian Avenue, W.C.1.

Sunray Tricity. No. 500,946. Class 18. Electric radiators for heating.—The British Electric Transformer Co., Ltd., Clayton Road, Hayes, Middlesex.

Britsulite. No. 492,509. Class 50. Electrical insulating materials.—The British Insulite, Ltd., Belfield Old Road Works, Rochdale, Lancs.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ABERYSTWYTH.—Pavilion (£20,000), with ballroom, &c., for the T.C.; clerk.

BEXHILL.—Hospital, Holliers Hill; G. H. Denne & Son, Ltd.

BIRMINGHAM.—1,138 houses, Allens Farm estate; W. Edwards, Contractors (Birmingham), Ltd. 40 houses, Fox Hollies estate; W. J. Simms, Son & Cooke, Ltd. Flats, Billesley Common estate; Trustees, Douglas Haig Homes. School extension, Hartfield Crescent; B. Whitehouse & Sons, Ltd. Junior commercial school, Sparkhill (£26,550); extensions, Erdington secondary school (£23,000); Education Committee. Welfare centre, Warren Farm estate; Medical Officer of Health. Extensions, Handsworth branch library (£5,100); city engineer.

BLACKLEY.—Additions, Vale Mill, for Connollys (Blackley), Ltd.; S. H. Burgess, 171, Cross Street, Sale, Cheshire.

BOGNOR.—Church, Linden Road; Sidney T. Hennell, architect, Bognor and London.

BROUGHTON (Kettering).—School for Northants E.C.; director of education, Northampton.

CANNOCK.—Nurses' Home (£7,149), for the B.G.; F. & E. Linford, builders.

CHADWELL HEATH.—Woodwork factory, near railway station; East Ham Woodcraft, Ltd.

CHEADLE (Staffs.).—Housing scheme (250), for the Berryhill Collieries, Ltd.

CHELTENHAM.—104 houses, Pilley Lane estate; Mr. Malvern, corporation architect. 91 houses, Skillicorne Avenue; S. T. Davies. 58 houses, Kipling & Shakespeare Roads, for Corporation; Mr. Rainger. Grammar school, for Gloucestershire E.C.; education architect, Gloucester.

CHESTER.—96 houses, Eaton Road site, for T.C.; Charles Greenwood, city surveyor (returnable deposit £2 2s.).

CHINGFORD.—Senior school (£18,044), for Essex E.C.; J. Stuart, county architect, Chelmsford.

CLACTON-ON-SEA.—Senior school (£20,313), for Essex E.C.; J. Stuart, county architect, Chelmsford.

CLITHEROE.—School, for E.C.; clerk.

COLCHESTER.—Home for mentally defectives, Royal Eastern Counties Institution; J. Stuart, architect, Springfield Old Court, Chelmsford (returnable deposit of £5 5s.).

DAGENHAM.—School, for Essex E.C.; director of education, Chelmsford.

DARLINGTON.—Employment exchange, for H.M. Office of Works, King Charles Street, London, S.W.

DARTFORD.—Technical college, for Kent E.C.; director of education, Sessions House, Maidstone.

DERBY.—Municipal aerodrome, for the T.C.; borough surveyor.

GRAVESEND.—Shops and flats, King's Farm housing estate (£12,000), for the T.C.; borough surveyor.

HALIFAX.—Refuse destructor and plant, Charlestown £9,000), for the T.C.; borough engineer.

HERNE BAY.—Extensions, holiday and convalescent home, St. George's Terrace; B. E. Dixon, architect.

HERTFORD.—Stores, Bengeo Street, for the Co-operative Society; secretary. Business premises, Parliament Row, for Morris & Sons; office extensions, Castle Street, for Herts. C.C.; county surveyor, Hatfield.

HODNET.—Senior school, for Salop E.C.; director of education, Shrewsbury.

HOUNSLOW.—164 houses, Elms estate; architects, Roper, Son and Chapman. 155 houses, Woodlands Gardens; R. T. Warren. Engineering works and iron foundry, near Southern Railway; S. S. Rogers.

HULL.—42 houses, Riversdale Road; F. Runton Waller. 34 houses, Westcott Street; Robinson & Sawdon. School, Eastfield Road (£15,498); R. G. Tarran. Three-storey flats, Barnelsy Street; municipal abattoir; city architect

KENT.—Two schools, Sandwich, two schools, Ashford, and central schools, Tenterden, Sheerness, Southborough, West Malling, and Tonbridge; director of education, Sessions House, Maidstone.

KIDDERMINSTER.—Garage, for the Birmingham & Midland Motor Omnibus Co., Ltd.

LANARKSHIRE.—Additions, Longriggend Sanatorium; P. C. Smith, district offices, Hamilton.

LEEDS.—40 houses, York Road site; city engineer. Shops and offices, Guildford Street site, for Corporation (£15,000); S. Butler & Co., Ltd.

LEICESTER.—Housing scheme, Braunstone estate; Douglas Haig Homes, trustees.

LIVERPOOL.—Church; Rev. C. R. Jarvis, curate-in-charge, St. Christopher's, West Derby. Schools, Ellergreen Road, Shiel Road, Wellington Road; director of education, Education Offices, Sir Thomas Street.

LONDON (Becontree, E.).—310 houses and flats and 39 shops (£169,000); L.C.C.

(Walthamstow, E.).—Town hall, for the U.D.C.; surveyor.

(Islington, N.).—Cinema, Essex Road, River Street and Astley's Row; A. G. Alexander.

(Hampstead, N.W.).—Tenements, &c., at Ken Wood (5,590). for L.C.C.; H. Lacey & Sons, Luton.

(Lewisham, S.E.).—193 houses, Downham estate; L.C.C.

(Brixton, S.W.).—Billiard hall, Brixton Road; Temperance Billiard Halls, Ltd.

(Kensington, W.).—Buildings, High Street and King Street, for Derry & Toms; B. George.

(Ealing, W.).—29 houses, Bennett's Avenue; W. J. Lanbridge & Co., Ltd., Parkfield Gardens, Harrow. Factory, for United Dyers & Cleaners, Ltd., Cambridge Yard; architect, R. A. C. Churchward, 12, Victoria Street, S.W.1.

(Strand, W.C.).—Extensions, Bush House; Bush House (Extensions), Ltd.

MANCHESTER.—Cinema, Clayton (1,200 seats); Moston Brick & Building Co., Ltd., Kenyon Lane, Moston. Offices, Charles Street, for Shaw's buildings, Ltd., Oxford House, Oxford Street; W. Longworth, 4, St. Mary's Parsonage. Showrooms and warehouse in High Street, Market Street and Teb Street, for Rylands and Sons, Ltd.; J. Gerrard & Sons, Ltd., Swinton.

MANGOTSFIELD.—School (800 places), for Gloucestershire E.C.; education architect, Gloucester.

MORDEN.—960 houses and flats, St. Helier estate (£595,000); L.C.C.

NANTWICH.—Additional 60 houses, for the U.D.C.; surveyor. Bazaar premises, High Street and Castle Street, for F. W. Woolworth & Co., Ltd., Kingsway, London.

OXFORD.—Church, parsonage and hall (£22,000); T. Lawrence Dale, architect, Oxford and London.

PRESTON.—Further housing scheme (275); borough surveyor.

RAWMARSH.—Additional 100 houses, Ryecroft estate, for the U.D.C.; surveyor.

REIGATE.—Handicraft and domestic science centre, for the E.C.; architect, Vincent Hooper, 7, Station Approach, Redhill, Surrey.

ROTHERHAM.—Out-patients' department (£20,000), for the Hospital Committee; George Saul & Sons, Ltd., builders, Kimberworth Road.

ROTHWELL.—Secondary school, for West Riding E.C.; director of education, Wakefield.

STAINES.—Housing scheme, Hanworth (124), for the R.D.C.; surveyor.

TWICKENHAM.—Development of Jubilee Farm estate (70 houses); Messrs. Barkers.

WALLINGFORD.—Water supply scheme, with engine, pumphouse and plant, Didcot, for the R.D.C.; Fiddian and Deeley, engineers, 13, Church Street, Stourbridge.

WALSALL.—Factory, Lincoln Road; J. A. Crabtree & Co. 107 houses, Blakenall and Broad Lane sites, for Corporation; H. W. Casey & Co. Housing scheme, 7 acres, Well Lane; borough engineer.

WATFORD.—Shops, flats and garages, High Street; W. Pryor. Bank, High Street; Westminster Bank, Ltd. Store, High Street; Grosvenor Battery Co. New block, Peace Memorial Hospital, Rickmansworth Road; committee. Alterations and additions, High Street; Bucks, Ltd.